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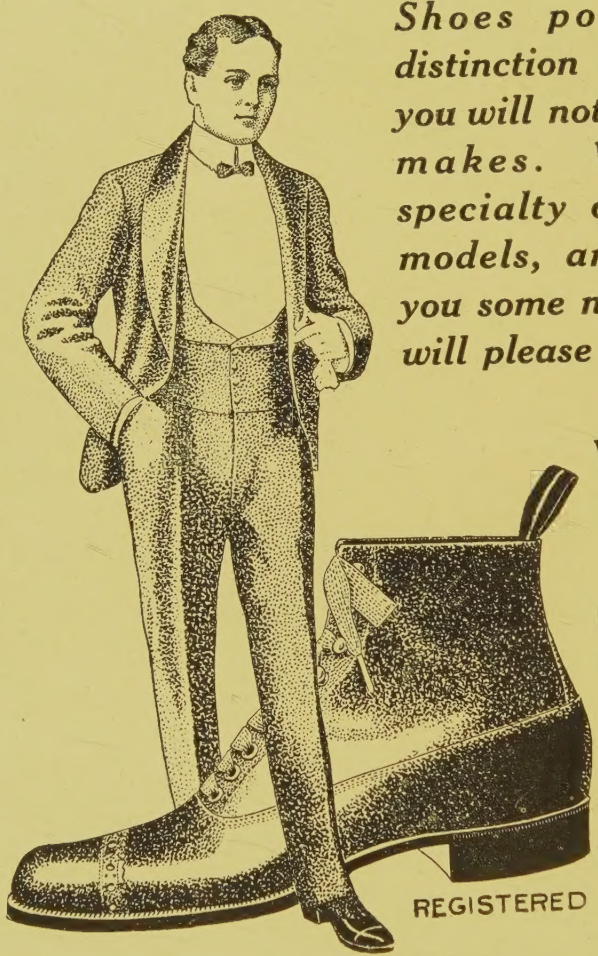

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The Philippine Chicken

By Vicente F. Allarey, B. S. A.

Thesis presented for graduation from the College of Agriculture. No. 8.

The object of the investigation which is here reported was to secure accurate data with regard to the physical characteristics of the Philippine chickens, as to the methods by which they are usually handled, their capacity to produce meat and eggs, and the effect of giving them such treatment as is usually considered necessary as a basis in handling improved breeds. This knowledge is necessary for judgment either on the present condition of the poultry business in these islands, or of the methods which should be advocated and adopted for the improvement of this business. As a basis for comparison, a study has of course been made of standard publications concerning poultry, and of numerous bulletins published by the Department of Agriculture and the various experiment stations in the United States.

From such general knowledge as is everywhere available in these islands, it was understood in advance that the Philippine chicken is at present producing less meat, and less eggs, than does any breed of recognized standing which has a place in the well developed poultry culture of Europe or the United States. To put the business here on a better basis, the first method to be tested is to give the native hens such treatment as is recognized as necessary elsewhere. At the same time, selection of large hens or especially fertile hens, or hens with both of these characteristics, should be practiced. At the same time, also, the native breed should be crossed with imported standard breeds; and experiments should be made with pure imported breeds. It may be surmised in advance that the use of the pure standard breeds will give the best results provided these will produce here as well as they do in other countries. However, there is no certainty as yet that this is the case,

and this method of improving the poultry business of an entire country is either very slow or very expensive. It is accordingly best to test the results which can be obtained by all of the methods just suggested.

There are no reliable data as to the size of the poultry business in these islands. Production and consumption are local, and there are no authentic statistics on either. According to the reports of the Collector of Customs, the quantity and value of eggs imported into the Philippines during the last four years have been as follows:

Year.	*Dozen.*	*Value.*
1908	2,536,627	₱507,322
1909	3,759,814	576,492
1910	4,136,366	561,574
1911	4,139,467	633,482

Domestic chickens are believed to be descended from at least two original species of wild fowls. First, *Gallus ferrugineus* or *Gallus bankiva*, which is still found in the jungles of India and in the East Indies. Second, the probably extinct progenitor of the Aseel or Malay fowls. The former of these has a slender body, single comb, slender willow-colored shank, and is capable of great flight; and the latter is very much like common domestic chickens of the Philippines. The Aseel has been bred in India for more than 3000 years, and its wild ancestor is not known. Philippine chickens came probably from the East Indies, and have, without doubt, crossed here and there with the native wild chickens, and probably have, for a long time, been somewhat mixed with strains imported from Mexico and the Asiatic continent.

Chinese poultry culture is ancient and their greatest skill, as well as that of the Hindoos, was exercised in breeding very large fowls. From these the heavy breeds of today have come. The Babylonian and Egyptian methods of breeding were very different from the Chinese. They were the peoples who introduced artificial incubation, and selected fowls that produced eggs continuously rather than those that laid fewer eggs and brooded in the natural way. The Egyptian chickens were imported into the countries bordering on the Mediterranean Sea and the egg breeds of to-day originated from them. The general purpose breeds were developed by selection, and crossing and grading Asiatic and Mediterranean breeds. The progress of domestication and improvement of fowls has been brought about by long continued attention to breeding and careful selection. Thus the three known types of chickens, Asiatic or meat breeds, Mediterranean or Egg breeds, and the American or General purpose breeds have originated. Chickens are so classified in Farmers' Bulletin No. 51, "Standard Varieties of Chickens," published by the Department of Agriculture of the United States.

The native chickens have no well established and well defined type. In general, they are small, active, nervous, and capable of great flight when frightened. They have no fixed color. Their shanks are not feathered. The skin is usually white, but sometimes yellow or black. The hens are fairly good sitters and mothers. They are seldom found in large flocks, but each family has usually a few. Practically no attention has been given to their breeding, except for the production of game cocks; and, excepting again the game cocks, they receive but little care. The cocks are fed with the best food and sheltered comfortably, while the hens are forced to rustle for their own food, and are exposed to whatever weather may obtain. A number of trips were

made for the purpose of studying the treament of poultry, and it was found that in general almost nothing is fed except corn and rice, and that not rarely the hens were obliged to find all of their own food. They are not properly housed nor given good nests. At the best, bamboo baskets covered with dry grass placed under the houses serve as nests, and the trees that happen to grow on the premises serve as roosts.

In May, 1911, thirty native hens were purchased, ten of which came from Batangas, five from Calamba, and the rest from Los Baños. They were selected as nearly as possible according to the method described in Bulletin 164, Kansas State Agricultural Experiment Station, entitled "Selection and Feeding of Laying Hens." This bulletin states that the comb, wattles and face are important indicators of disease or poor constitution; that the breast should be broad and long, sloping upward, that the back should be long and broad; and, that the abdomen should be wide and deeper than the breast. It also states that shanks should be well spread and of medium length. The fowl should be V-shaped in three ways, viz: (a) on sides, front to rear, (b) top and bottom, front to rear, (c) base of tail, downward.

These hens were placed in an up-to-date poultry house and a pure bred White Leghorn cock was placed with them.

The house is 14 feet long, 10 feet, wide, 9 feet high in the front and 7 feet high from the sill to the plate in the rear. The floor and foundation walls are of cement. The corner studding is of 4 × 4 inch material and rests on a concrete foundation. The remainder of the frame is 2 × 4 inch material. The walls are of tongued and grooved lumber. The roof is corrugated iron. The house has two windows, one in front and the other in the rear. The nests are arranged in such a way that they are in a dark place, readily accessible to the hens, and can be easily cleaned and disinfected. Clean dry cogon or excelsior was found to be satisfactory for the nests. The perches are 2 × 2 inch scantlings set edgewise with the upper corners rounded. Below these perches is a small smooth platform placed so as to catch the droppings. The platform is covered with sand so that the droppings can be taken out with a small amount of work. There are two purposes for this platform, to prevent the droppings from soiling the floor and to save them for fertilizers. The yard or run is 50 feet long and 40 feet wide, enclosed with two-inch mesh wire netting about 7 feet high.

The first feeding experiment began June 1st, 1911, and lasted until August 31st, 1911. The feed fed consisted of corn and green Guinea grass. Fresh, clean water, grit and charcoal were furnished during all of the experiments. At the end of two months the hens had laid only 131 eggs or an average of less than five eggs each in 61 days. During August they were allowed to leave the yard in the morning after the feed was given and were shut in again in the evening before they were fed.

EGG PRODUCTION.

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	*Total*	*Total feed lbs.*
June...	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	2	1	9	1	1	1	1	1	0	0	0	56	120
July...	0	1	1	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	75	124
Aug...	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	4	4	84	124
																																215	

In figuring the gain or loss the corn was valued at 2.7 centavos a pound and the eggs at 50, 40 and 30 centavos a dozen. In this experiment the total number of eggs, which is 215, were worth, at 50 centavos a dozen, ₱8.96; at 40 centavos a dozen, ₱7.16; and at 30 centavos a dozen, ₱5.37. The cost of the 368 pounds of grain fed was ₱9.93. There is a loss of ₱.97, ₱2.77, and ₱4.56 respectively.

As a matter of fact, eggs were sold at first for 3 centavos each for a short time; then at 40 centavos a dozen; and toward the end of the year at 50 centavos a dozen.

Allowing the hens to run out a part of the day apparently increased the egg production, since 28 more eggs were laid in August than in June and nine more than in July. June and July were wet months, but the latter part of August was drier; and dry weather continued throughout the year.

During these three months the rate of egg production was only 28 eggs a year for one hen.

The next experiment began September 1, 1911. The chickens were weighed to find out their total weight so that the standard ration for laying hens, given by W. H. Jordan could be determined.

The feed was a mixture consisting of two parts corn, one part mongo, and one part cowpeas. The chickens were confined in the yards and fed this ration until October 31.

EGG PRODUCTION.

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	20	30	*Total*	*Total feed lbs.*
Sept...	4	5	5	5	6	5	6	6	6	5	5	4	4	4	4	4	4	4	4	3	2	3	3	4	4	4	4	4	0	1	0	123	120
Oct....	2	2	2	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	127	124

The proportion of the above mentioned feeds furnished the nutrients required in the standard used. The nutritive ratio was 1 to 4. 6.

In this case the corn is valued at 2.7 centavos a pound, mongo 6 centavos, cowpeas 6 centavos, and the eggs, at different prices as shown above. Comparing the value of the eggs, which is ₱10.41 and the feed, which is ₱8.54 there is a profit of ₱1.87; but, if the selling price of the eggs is ₱0.40 a dozen, there is loss of ₱0.21, and if it is reduced to ₱0.30 there is loss of ₱2.50.

During the months of September and October the egg production for one year was 50 for each hen.

Records of egg production were continued for the month of November; during this month the hens were kept in the yards and fed about two pounds of corn a day together with a liberal supply of table scraps taken from the slop cans at Camp Eldridge. This waste material contained a large amount of bread scrap, rice, meat and beef bones. The value of the corn fed was ₱1.60.

EGG PRODUCTION.

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	*Total*	*Total feed lbs.*
Nov...	3	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	6	6	6	6	6	6	5	5	6	4	6	4	132	60

The rate of egg production for one year as figured from the results obtained during this period is almost 52. When the cost of the corn is taken from the value

of the eggs there is a profit shown of ₱3.90, ₱2.80, and ₱1.70, respectively.

During the months of December, 1911, and January, 1912, the hens were given the same conditions that are common to native hens. They were allowed to run out and rustle for themselves and no extra feed was given. The record of egg production is as follows:

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	*Total*
Dec.	4	4	4	3	6	6	4	4	5	5	5	5	5	5	6	6	5	5	4	4	4	5	5	4	4	4	4	4	4	4	2	139
Jan.	1	1	1	1	1	1	1	1	2	2	3	4	4	4	4	4	4	4	6	5	6	5	5	5	4	5	5	5	5	5	4	108

The rate of egg production for one year is 50.

The value of the eggs at the prices above is as follows: At 40 centavos a dozen, ₱8.23; at 30 centavos a dozen, ₱6.17; and at 50 centavos a dozen, ₱10.29.

Another feeding experiment began on February 7th, 1912, and lasted till February 28th, 1912. Twenty chickens were divided into two pens, 10 in each pen. Pen No. I received nothing but cracked corn while Pen No. II received cracked corn and crushed feed. The crushed feed is a mixture of ground oats, barley, corn, wheat, cow peas and wheat bran. It is claimed by the company that sells it to contain a narrow nutritive ratio.

EGG PRODUCTION FOR FEBRUARY.

No. hens.	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	*Total*	*Feed lbs.*
Pen. I.	4	4	3	3	4	2	2	2	2	2	2	3	3	4	2	2	2	3	3	3	2	2	58	44
Pen. II.	4	5	5	5	5	2	2	2	2	4	4	4	4	5	2	2	3	3	2	2	2	0	69	55

Cracked corn mixed with crushed feed gave more satisfactory returns than corn alone. Pen I consumed 44 pounds of corn worth ₱1.18. The eggs will sell at a profit of ₱0.27 ₱0.75, and ₱1.23 at the prices, 30, 40 and 50 centavos a dozen. For Pen II, feed cost ₱1.50 making the profit on the eggs, at the different prices, ₱0.23, ₱0.80, and ₱1.37, respectively.

During the experiments with the 30 hens, which lasted 8 months, a total of 844 eggs were laid. At this rate of egg production, one hen will lay 43 eggs in one year. By comparing this figure with the number of eggs laid by one hen in one year, as given in Bull. 99, Kansas Agr. Exp. Station, for Standard Breeds of Chickens, we can see that the native hens in this experiment made a very poor showing.

EGG RECORD.

Breed.	*No. of Hens.*	*Total per Year.*	*Average per Hen.*
Plymouth Rock	10	1411	141.1
Wyandotte	6	661	110.16
W. Leghorn	7	769	109.45
B. Orpington	8	865	108.12
Phi. Hens (native)	30	1296	43.00

But the greater number of eggs that the standard breeds produced was not the only difference noted. The native hens' eggs are very small. Ninety-eight dozen eggs were weighed and the average weight determined. The weights of the

ninety-eight dozen native eggs are shown in table No. I, given in detail to show the uniformity.

TABLE I.

Table showing the weight of eggs of native hens per doz. In ounces.

No. of doz.	*Weight.*	*Origin.*
1	18.5	Los Baños
1	18.0	"
1	17.5	"
1	18.0	"
1	18.0	"
1	18.1	"
1	18.5	"
1	17.0	"
1	18.0	"
1	18.1	"
1	18.0	"
1	18.0	"
1	18.6	"
1	19.0	"
1	17.6	"
1	19.0	"
1	18.6	"
1	17.0	"
1	18.0	"
1	18.0	"
1	18.0	"
1	18.1	"
1	17.5	"
1	17.0	"
1	18.0	"
1	18.5	"
1	18.1	"
1	18.0	"
1	17.9	"
1	18.5	"
1	17.9	"
1	18.1	"
1	18.0	"
1	18.0	"
1	18.0	"
1	18.0	"
1	18.0	"
1	18.0	"
1	18.1	"
1	18.9	"
1	18.0	"
1	17.6	"
1	17.9	"
1	18.6	"
1	18.6	"
1	18.4	"
1	17.9	"
1	18.1	"
1	18.0	"
1	18.0	Lucena
1	17.1	"
1	17.1	"
1	17.5	"
1	17.6	"
1	18.1	"
1	18.0	"
1	18.0	"
1	18.0	"
1	17.1	"
1	16.1	"
1	17.6	"
1	17.9	"
1	18.0	"
1	18.0	"
1	17.5	"
1	18.0	"
1	18.1	"
1	18.1	"
1	17.6	"
1	18.0	"
1	18.1	Manila
1	17.6	"
1	19.0	"
1	17.0	"
1	18.0	"
1	17.9	"
1	18.1	"
1	17.8	"
1	18.0	"
1	18.9	"
1	17.1	"
1	17.8	"
1	18.0	"
1	18.0	Calamba
1	17.1	"
1	18.1	"
1	17.5	"
1	18.0	"
1	18.0	"
1	18.0	"
1	18.0	"
1	18.1	"
1	17.9	"
1	17.6	"
1	17.8	"
1	17.9	"
1	18.0	"

Place.	*No. of Doz.*	*Aver. Weight.*
Lucena.....	21	17.69
Manila.....	13	17.95
Calamba.....	14	17.86
Los Baños.....	50	18.01
	98	17.91

It will be observed that the Los Baños eggs were appreciably heavier than any of the others. It might possibly be ascribed to good luck in the selection of the hens, but is more probably due to the better treatment which our hens received,

It has already been noted that the native chickens are much lighter than even the standard egg breeds. Standard weights for certain of the well established

breeds of chickens may be given as follows:

Breed	Cocks lbs.	Hens lbs.	Cockerel lbs.	Pullet lbs.
Brahmas	12	9½	10	8
Cochins	11	8	9	7
B. Langshans	10	7	8	6
Leghorn	5½-6½	4½-3½		
P. Rocks	8	7½	8	6½
Wyandotte	8½	8½	7½	5½
Native	4	2		

To get a reliable average for comparison with these figures, 232 chickens, obtained in five different places in the Island of Luzon, have been weighed. The number weighed from each place and the average weights are as follows:

	Locality	No. Weighed.	Aver. Weight.
Cocks	Los Baños	20	3.815 lbs.
	Manila	14	3.922 "
	Batangas	25	4.119 "
	Calamba	15	3.730 "
	Lucena	26	3.912 "
		100	3.928 lbs.
Hens	Los Baños	31	2.543 lbs.
	Manila	22	2.493 "
	Batangas	29	2.298 "
	Calamba	30	2.061 "
	Lucena	20	2.547 "
		132	2.536 lbs.

CONCLUSIONS

The records which are given above show that the native hens are not good producers of eggs. They seldom lay more than eight eggs in one laying period, and often become broody after laying five or six. These hens were certainly kept under much better conditions than are usual in these islands. While their production of eggs is very low, it is still but little lower than that of common unimproved hens of other lands.

It is also demonstrated above that the native hens will not produce profitably if confined to the yard. They made better records when allowed their freedom, and forced to rustle for at least a part of their feed than they did when they were well fed and kept in the pens.

The native egg has been shown to be much smaller than eggs laid by Plymouth rocks, Orpingtons, Leghorns or any of the other common pure breeds of chickens.

The weight of the native chickens as compared with that of even the standard egg breeds is found to be surprisingly small. This is so emphatically the case that there seems to be little chance of developing a meat breed by crossing the native chickens with the meat breeds of other lands.

While the native chicken is neither a meat nor an egg producing fowl, its ability to rustle for itself and still lay a limited number of eggs makes it admirably suited for the conditions under which it is at present grown. If fowls of standard breed were treated as these usually are, their failure to produce would probably be still more complete.

In connection with this study, it was found that setting hens were troubled much by mites. The nests were burned out and treated with sulphur when mites were found, but it was necessary to repeat this treatment so often that it became quite a task. Following local practice, the leaves of *alagao*, a small tree of the genus *Premna*, were placed under the bedding of nests and found to prevent mites from appearing at all.

The Duck and Egg Business of Pateros

By Mariano B. Raymundo

The town of Pateros has its name because of its duck industry. It is situated some ten miles from Manila near the Laguna de Bay on what was once the head of the Pasig river. About two generations ago an artificial channel was made connecting the lower end of the Mariquina river with the Pasig, and another channel was made diverting the water of the Mariquina river so that it enters the Pasig at a point lower down. Since that time, the old lower course of the Mariquina has been the outlet of the lake, and the towns of Pateros and Taguiig had been left to one side.

According to the old men of Pateros the duck business was introduced by Chinese who settled in the town as long ago as the discovery of the islands by the Spaniards. Legend says that these were Chinese traders who came to Manila and took refuge from storms in the river, and in this way happened to become acquainted with the advantages of the place for the establishment of a duck industry. The river no longer exists here, but when wells are dug along its line, Chinese dishes, vases of blue color, and implements are found, which the people believe to come from Chinese boats which were sunk here. Moreover, all the names of the articles used in the local duck business are originally Chinese words.

In the course of time, the industry developed until a considerable town grew up which depended entirely upon the one business. This prosperity continued until the Philippine revolution. During the time of war the people of Pateros fled to the mountains and were afraid to come back. Chinamen from Manila are said to have come then to Pateros and to have taken all the ducks they could find and sold them in the city. After the revolution the surviving ducks were recovered by their owners and cared for; but labor was then scarce and expensive. At about the same time the snails, which had been the chief food of the ducks, became very scarce; so most of the owners decided to take their ducks to towns where snails were plenty. The places to which the raising of the ducks was transferred are Angono, Binangonan, Cardona, Morong, Baras, Tanay, Pililla, Quisao, Jalajala, Taguiig, and Muntinlupa, all in Rizal Province; Santa Cruz, Calamba, and Los Baños in La Laguna; and Malolos, Calumpit, and Paombong, in Bulacan. Some of the owners emigrated with their ducks while other more wealthy ones sent their servants to tend them. In the course of time the servants sent in charge of ducks became tired of their jobs, receiving salaries as low as ₱30 per annum; the owners then became disgusted with the business and sold their ducks to the people of the towns to which they had been sent. But to keep up the business in eggs they build artificial incubators in Pateros and buy the eggs to fill these from the people in the towns where their ducks were sold.

THE CARE OF THE DUCKS.—When the ducklings are only two or three days old they are divided, the males from the females. The most of the males are sold, either immediately to people who make a business of rearing them for the market or directly to the market when they are four to six months old. The ducks which are to be kept are put into groups of about 500 each, 50 males and 450 females. Each of these groups is put into a big bamboo basket two or three meters

in diameter and three or four decimeters high. The bottom of the basket is covered with dry straw to keep the ducklings warm. On sunshiny mornings these ducks are taken out and the little birds are given a sun bath. They are fed with the larva, pupa, and adult of an insect locally known as "gamo-gamo" when adult, or as "bahay-uod" in the larval and pupal forms. The "gamo-gamo" is common in bamboo groves during dry weather, and the "bahay-uod" is taken from the bottom of the lake. Boiled rice is also given to the young ducks, but care is taken not to overfeed them. When the insects are not available, small shrimps are minced and fed with the rice. Five days after the ducklings are put in baskets, their normal diet is changed to shrimps and boiled rice given three times a day. When they are about a month old, they are turned loose in small bamboo pens each of about 12 sq. m. Each of these pens connects with a shed of the same size. In these pens they are fed on unhulled rice (palay), and on clams or snails from which the shells have been pounded off.

When the ducks are four months old, they are put into larger pens each of which is five meters wide, and has a length of eight meters, half of which is on the land and half in the river. Each pen also connects with a shed five meters wide, and six meters long. The floor of the shed or dormitory is covered with rice hulls to keep it warm and dry. From time to time this bedding is removed, with the droppings of the ducks, and sold for a fertilizer to the growers of betle leaf. The ducks in these pens are fed twice a day with a basket of mollusks containing all they want, and once a day with a ration of five liters of rice. If they are well cared for, the ducks begin to lay after four months in these pens, but if they are not properly treated, it may be nine or ten months before laying eggs.

The adult ducks have the same care as those somewhat younger. They may be left in the same pens, but it is considered better treatment to put them into larger enclosures and to have fewer ducks in a group.

INCUBATION. The object of the duck and egg business in Pateros is the production of "balut" or eggs which have been partly incubated and are sold and eaten in this condition. As the ducks are non-setters, incubation has to be artificial, and is carried on in houses known as "balutan" constructed for this purpose. The building itself is a low one with bamboo walls and a nipa roof. The eggs are placed in deep cylindrical baskets. Each cylinder is 18 inches in diameter and 24 inches deep. These are arranged in two ways. The less common way is to have a single row along the wall; this arrangement is called "panabi". The more common arrangement, called "de cajon", is to have a double row in a long box which is placed in the middle of the house. This box is made of bamboo or of wood and is made with tight sides and with a bamboo floor or on the ground. The bottom is then covered 10 cm. deep with firmly tamped rice hulls. The cylinders, called "toong," are then put in position on this body of hulls. If the arrangement is "de cajon," the cylinders are 5 inches apart and 4 inches from the sides of the box. After the cylinders have been put in place, the box is filled full around them with rice hulls so that it gives the appearance of a table with two rows of wells in it. The entire floor of the building is also covered three or four inches deep with well tamped hulls, which are said to serve to keep it dry and uniformly warm. The roof of the building is fitted with

ventilators which can be opened and shut with levers.

The eggs come to the building in "kaeng" or baskets made to hold 500 eggs each. The first thing done with the eggs is to separate out all which have thin shells. This is done either by snapping the eggs with the finger, hard enough to break thin-shelled ones, or by looking through an egg tester. The latter consists of a hole through a board; eggs with thick shells can be distinguished by their darker color. Thin-shelled eggs whether cracked or not are immediately marketed as fresh eggs; the subsequent treatment demands thick shells in order to avoid breaking.

The selected eggs,—that is, thick-shelled ones,—are then placed in the sun and allowed to heat until they become moist. If there is no sunshine, the eggs are put immediately into the "toong" and heated with palay. For this purpose the palay is heated in an iron cauldron until too hot for the hand.

Assuming that the initial heating has been in the sunshine, the eggs are then put 125 together on a piece of coarse abaca cloth about 90 cm. sq., and the corners of the cloth are then tied tightly together forming a sack. Five liters of palay at a temperature of 32 to 34 degrees are then tied into a similar sack and placed in the bottom of a cylinder. On this is placed a sack of eggs. Alternate layers are put in until there are eight layers of eggs. Over the last layer of eggs are placed two layers of the palay.

When the eggs have been incubated in this way for about five days, they are put into other cylinders in combination with fresh eggs, for the purpose of heating the fresh ones. If this were not done, the temperature of the eggs left to incubate all together would rise sufficiently to kill the germs. Accordingly, if fresh eggs are not available it is necessary to take the old ones out of the cylinders to cool for a time in the air. The combination of eggs of different degrees of incubation is called "lansacan". The arrangement is as follows: At the bottom of the cylinder is placed a layer of rice as already described. On this are placed two layers of the five day old eggs. On this is another layer of rice; then two layers of new eggs; then a layer of rice; then two layers of five day old eggs; another layer of rice; and two more layers of old eggs, and finally on top two layers of rice and a thick rice sack. In each cylinder there are then six layers of five day old eggs, two layers of new eggs and six layers of rice.

This is only the first step in this treatment. For as soon as the house comes to contain a variety of eggs of different stages the bottom layers will be thirteen days old, the next two layers nine, the third two five, and the top ones seventeen days old. During the dry season the eggs are transferred from one cylinder to another every day, and during the wet season twice daily. The seventeen-day old eggs are always kept on top and are accordingly there on the 18th or 19th day, at which time they are ready to be marketed as "balut". The shifting of the eggs, done daily or twice daily according to the weather, must be done by very skilful operators, or an unnecessary number of eggs will be spoiled. In this operation the rice sacks are lifted from the cylinder and tightened until instead of being flat they are spherical, and put down with the knot on the under side. The egg sack is grasped by the intersection of the corners, lifted a little, and turned in a circle until all the eggs are collected in the middle; it is then lifted from the cylinder and transferred to the other. The eggs which were before toward the middle of the box are now placed on the outside.

This is because the part of the cylinder which is toward the outside of the box is slightly cooler, and by changing the position of the eggs all of them, day in and day out, are kept at practically the same temperature.

During cold weather the rice is warmed in an iron cauldron which fits the top of a stone fire place. It is heated to 36 to 37 degrees C., and immediately put into the abaca sacks and carried to the incubator and piled in sacks. The rice for this purpose is used over and over and lasts for two years or more.

EGG TESTING. When the eggs have been incubated for thirteen days, they are tested as to fertility. This is done by the usual method, that is by looking through them at the light and turning them. Those which are infertile are sold immediately under the name of "penoy". Their price is ₱25.00 a thousand. About 10% of the eggs are usually penoy, but the proportion may run as high as 50%.

BUSINESS DATA. The cost of building a moderate sized "balutan" with the fixed equipment is about ₱300.00. One of this size holds 32 cylinder and can produce 10,000 "balut" every eight days. In the towns where the eggs are bought their price is ₱25.00 a thousand. Transportation to Pateros costs ₱2.00 a thousand. The cost of incubation is about ₱1.00 a thousand and the "balut" are sold at ₱37.00 a thousand. The profit is, therefore, ₱9.00 a thousand on the "balut," but against this there is a slight loss due to breakage and to the penoy. With good luck, the profit on the business will pay back the cost of the "balutan" during the first month of its operation.

The demand for "balut" at present is in excess of the possible present production. A taste for the article is spreading in the southern provinces. Practically the whole output of Pateros is shipped to Manila and sold to Chinese merchants who distribute it to the provinces. The greatest demand is in the Kapampangan, Ilocano, Pangasinan, and Tarlac provinces; next, in Batangas, Bataan, Cavite, Tayabas, and La Laguna. Fresh eggs are also in great demand by bakeries of Manila and neighboring towns; but all the fresh eggs that can at present be produced by the towns which supply Pateros are not sufficient to keep the "balutan" in full operation. As a rule, the egg buyers visit these towns once in four days. More frequent visits would make the collection too expensive, and less frequent ones would not do because eggs more than six days old are too likely to be infertile. At each collection the towns in Rizal contribute fifty to seventy-five thousand eggs, and the La Laguna towns six to ten thousand. The local production in Pateros is almost insignificant. Pateros has twenty "balutan" with a total capacity of about twenty-six thousand eggs a day, but the supply is only fifteen to twenty thousand.

Study and Dairy Profits

The United States Department of Agriculture, Bureau of Animal Husbandry, in its bulletin No. 164 issued February 27, 1913, publishes records on dairy herds in various parts of the northern and eastern of the United States, compiled from the original record of investigations conducted by Mr. W. D. Hoard, formerly Governor of the State of Wisconsin. These records cover 2163 herds and 28447 cows. These records, made on such a scale, bring to stronger emphasis than ever the fact that the dairy business must be understood, must be a real profession, in order to be likely to be profitable.

The business is taken up in various details showing for the different herds the class of cattle kept, the class of stable, method of feeding, etc. To a very considerable extent, owners whose business was well run in one respect was well run in the other respects studied, and in these cases it proves profitable in a very high percent of herds. On the other hand, if badly run in one respect, the other methods were likely to be unintelligent and slipshod also. "The ratio of profitable to unprofitable herds is more than seven times as great among herds in good stables as it is among herds in poor stables."

As a feature of general interest, the most striking is probably the demonstration of the result of education, which is expressed here by the statement that owners do or do not read current periodicals on dairying. Thus, under Canvass No. 5 in Susquehanna County, Pa., we find "The average net profit of dairymen who read is five times that of those who do not read." Under Canvass No. 7 in New York, "The readers receive nearly three times the average net profit of the non-readers." Under Canvass No. 8, also in New York, "The ratio of profitable and unprofitable herds is nearly three times (2.9) as great among the readers as among those who do not read." Under Canvas No. 10, also in New York, and among members of a milk association "The two men who are especially noted as great readers and students of dairying, receive respectively $2.21, and $2.27 for each dollar spent in feed." "The average gain of those who read over those who do not read amounts to $7.06 per year for each cow." Under Canvass No. 12 in Ohio, "Readers of dairy literature receive four times the net profit of those who do not read." In this canvass twenty-two men were returned as reading dairy literature, and thirty-seven as reading agricultural literature; all of these had profitable herds. Of twenty-four who were returned as reading neither of these, eight had unprofitable herds. Under Canvass No. 16 in Vermont, "Men who read dairy literature earn with each dollar spent in feed 45 cents more than men who do not read." Under Canvass No. 17, in Minnesota, "The ratio of profitable and unprofitable herds is 58 times as great among the readers of dairy literature as it is among those who do not read." Under Canvass No. 18 in Wisconsin, "The seven readers of dairy literature receive a net profit per cow per year of $12.92 more than the ones who do not read." For the average herd of fourteen cows, this means $180.88 added to the owner's profit for studying his own business.

How many farmers in the Philippines read papers or magazines devoted to agriculture?

E. B. C.

Photosynthesis in Passiflora

By Toribio N. Vibar

As a part of the class work in Botany III a quantitative determination was made showing the amount of starch and of reducing sugars in the leaves of Passiflora quadrangularis. Four leaves approximately the same age were selected for experiment. These were shaded in bamboo tubes, the openings of which were so shut that no light could possibly enter. After two days in these tubes, the leaves were uncovered. Two of them were immediately dried at 100°C. The other two were exposed to full illumination for two days, at the end of which they too were dried. Just before drying, the area of each leaf was determined.

After drying, the leaves were powdered and the sugars extracted with alcohol. This solution was bottled after the addition of enough alcohol to preserve it. At the end of thirty-four days, there had been no apparent change, and the reducing sugars were determined with Fehling's solutions. The starch (and hemi-celluloses) were hydrolized with 2% HCL for thirty minutes, and the reducing sugar obtained was determined as before. The results of analysis are shown in the following table:

	Area of the leaf in sq. cm.	*Dry wt. of the leaf in grams.*	*Total amt. of Cu. obtained.*	*Equivalent amt. of dextrose.*	*% of dextrose by wt.*	*Total amt. of Cu. obtained.*	*Equivalent amt. of starch*	*% of starch by wt.*
Leaf I....	144.65	1.3794	0.0328	0.01487 a	1.07	0.1392	0.0568 a	4.11
Leaf II...	129.66	1.0639	0.0216	0.009795	0.92	0.0912	0.0372	3.50
Ave. %...					0.995			3.81
Leaf I....	152.94	1.2963	0.0550	0.02494	1.92	0.2056	0.0839	6.47
Leaf II...	123.71	1.0591	0.0436	0.01977	1.86	0.1256	0.0512	4.48
Ave. %...					1.89			5.66

a. As directed by Detmer-Moor ("Practical Plant Physiology", page 295, 220.5 CuO=100 parts grape sugar=90 parts starch.)

CONCLUSIONS.

First. During two days in total darkness, the amounts of starch and of reducing sugar decreased, but neither is nearly exhausted.

Second. The amount of starch and hemi-celluloses in the leaves of Passiflora quadrangularis exceeds in all cases the amount of reducing sugars present.

Third. Averaging the amount of total carbohydrate in the two leaves analyzed after shading, and in the two leaves analyzed after two days of illumination, and subtracting the former from the latter, a difference is obtained which, if calculated as per square meter, and for the hour of day-light, shows a formation of 6.6 grams of carbohydrate. Practically all of the photosynthesis is effected during a few hours of most intense insolation during which the rate of formation of carbohydrate must be computed as more than twice that just given. To get the actual rate of photosynthesis in full sunshine, a further correction would have to be made for carbohydrate consumed by respiration during the experiment, and for that which was moved out of the leaf.

The Pomelo

By C. F. Baker, *Professor of Agronomy.*

The matter of pomelos, it appears to me, is one of the most important from the pomological point of view, in subtropical horticulture. Everywhere in the tropics and subtropics there are numberless forms of this most valuable and healthful fruit—in my opinion a far more valuable fruit in its better forms than the orange. Named varieties are few in the United States or elsewhere, mostly inferior in value, and are not well known even among planters; indeed they are often hopelessly mixed in planted groves.

Thus, any one of several very distinct nearly seedless forms is likely to be called Marsh Seedless. Some of the best passing under this name in Florida are really superb fruits, thin skinned, with melting pulp reeking in juice, few seeds, and when well cured, sweet, and with only enough bitterness to give them an appetizing tang. In planting pomelos in the States, I should spare no pains to get buds from such stock. Speaking in terms of really fine pomelos most of those now appearing in the States markets are scarcely fit for the table—thick skinned, full of seed, and excessively sour and bitter. Yet in many Eastern cities a person can get one of these poorer fruits on the restaurant table only by paying a fairly shocking price. Suppose the market could be supplied with an abundance of really fine pomelos! I believe they would eventually become more eagerly sought and more widely used than the orange, for the best pomelo is a finer fruit than the best orange.

Southern California can produce as fine pomelos as any part of the world, but only on the best soils and with abundant fertilization and irrigation. It is not being done now, because no consistent effort in this direction has ever been made, no gathering together of all the known varieties from every source and trying them out thoroughly under the varied conditions of the South.

I have advocated strongly the immense importance for Southern California of such work not only in the matter of pomelos but also in many other things. Every year it is deferred means another year of possible development and advancement lost. Private planters cannot undertake it. The State and the Federal government, or privately endowed Pomological Gardens, should.

The "native" pomelo in the Philippines which I find common here everywhere is one of the poorest fruits of the sort I have ever seen in any subtropical region, thick skinned, abundantly seeded, and extraordinarily tasteless and coarse. I believe it will make a good root stock for these regions. I had not been here long when Mr. Cuzner of the College of Agriculture called my attention to a pomelo he had received from Hongkong, apparently from the region about Canton. It is a large fruit and one of the most uniquely valuable pomelos I have ever seen or heard of. The skin is not very thick and may be readily stripped from the fruit although not loose as in a tangerine or mandarin. The sections are large, few seeded, the pulp sacs very large and very juicy and tender. It is very slightly necked at the stem and most remarkable of all the skin of the sections can be as easily stripped off as is the peel, thus rendering it the *ne plus ultra* of pomelos for table use. Its flavor is exquisite, very sweet, slightly aromatic and with the bitterness confined to the dissepiments. It is doubtless one of the Amoy group of pomelos, but is

unlike any previously described or figured, so far as known to me. This remarkable pomelo, which I am naming the Cuzner Pomelo, we are planting in seed only, and I have sent several seed to Southern California, to Mr. Popenoe and to Mr. Cornell; though this is to a large extent a futile operation it is still an interesting one. But here is the vital point. Why in the world has not Southern California long since ransacked Southern China, Indo-China, Burma, Siam, India, the Malay States and Islands, and Ceylon, where citrus fruits have been raised for countless centuries and where continual seed planting has now prepared for a possible selection that will out-Burbank any operation of the sort ever undertaken by Burbank—to bring together in her most favored localities for exhaustive trials, all these most valuable varieties now unknown to Pomology! Similar things have been done for the alfalfa, the wheat, and oats and other industries and California has covered these same countries in repeated quests for insect parasites.

Now, it seems to me, *before* the great 1915 Exposition, is her time to get busy and take this work up on a comprehensive and adequate scale and push it forward energetically. She cannot afford to waste a day in getting at these great opportunities. I am remarking the same thing of the Philippines—here, in easy striking distance of some of the greatest horticultural opportunities in the whole world, and yet I cannot get a good orange or pomelo in the home market, unless it be brought from China, near by, tea unless from Formosa, coffee unless from Java or Sumatra, cacao unless from Ceylon or Malay States, and yet it is perfectly fair to say that the Philippines would raise as good of these as any other country. But we must get out forthwith and go after them, nothing whatever will take the place in effectiveness or certainty of results of expert personal work in the field.

Fertilizers in Japan

Nos. 13 and 14 of Volume 2 of The Far East, a weekly magazine published in Tokyo, contain a very interesting paper on Japanese Agriculture by Mr. John Struthers. Mr. Struthers was formerly lecturer on agriculture and chemistry at the West of Scotland Agriculture College, and is at present agricultural chemist and manager in the far east to the Chilian Nitrate Propaganda. The paper deals chiefly with the use of fertilizers in Japan. As is well known, the Chinese, like the Japanese, waste nothing which can contribute to the maintenance of the fertility of their land. The value of the domestic products which find a use in this way is naturally hard to calculate; estimates place this as high as 150,000,000 yen a year (a yen equals one peso). Besides this, there is a very important importation of fertilizing materials. The value of the fertilizers imported as such in 1911 was 51,418,070 yen. Besides this, there was an incidental importation of material finally used in this way valued at perhaps 15,000,000 yen. The fertilizers imported as such amounted to more than 10% of the total imports and this ratio is increasing. Great as these figures are in comparison with the fertilizers brought into the Philippines, Mr. Struthers shows that they themselves look small in comparison with the annual importation into the United Kingdom. His full paper is to be published in the transactions of the Asiatic Society of Japan.

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This number of *The Philippine Agriculturist and Forester* will serve as an exposition of the work which the College is doing with poultry. Aside from the subjects which are treated in Mr. Allarey's paper, the college is studying the adaptability of several pure breeds to local conditions, and is raising for future study grade chickens,—crosses between these pure breeds and the native fowls. The pure breeds at present here are the Chinese, Langshan, Leghorn, Black, Orpington, and Barred Plymouth Rock. For this work, the college has built four poultry houses, each with its runway as described by Mr. Allarey, and a series of brood pens, sheltered, and, for the sake of dryness, placed on a concrete floor. No animal industry of these Islands is more important or gives greater promise of development than the poultry business. The College has not taken the initiative in the introduction of races of fowl into these Islands and does not expect to do so. Private enterprise has already done what was most necessary in this direction. In the careful study of pure breeds, of grades, and of the native chickens, and of the response of all of these to different methods of treatment, the College is doing a work which is usually impossible in private hands, and work the result of which will be given full publicity.

In connection with the introduction of high-grade poultry and its popularization, the work which has been done in some of the Manila grade schools is entitled to highest praise.

"A Great Loss"

We take the liberty of copying the following statement by Professor Baker's old associate, Professor A. J. Cook, published in the monthly bulletin of the California State Commission of Horticulture for July 1912.

"The resignation of Prof. C. F. Baker, as head of the department of biology of Pomona College, to take a similar position in the Philippine Islands at a salary of nearly three times the amount paid him at Pomona, is a grievous loss to the students of Pomona, to Pomona College and to the State. Professor Baker, while yet a student in college, made a phenomenal record. Upon graduation he had a collection of plants and insects, many of them accurately named, which would eclipse that of many a veteran in the science of biology. As a teacher in the St. Louis (Missouri) High School, Colorado Agriculture College, Alabama Polytechnic Institute, and at Pomona College, he inspired a large group of the brightest students to a pitch of endeavor and accomplishment which is rarely equaled. As an investigator, he showed rare ability. His work in Cuba and in Para, Brazil, was so highly appreciated that he had repeated offers of $5,000 a year to return to the position he had so successfully filled. As a collector, to quote in substance Dr. David Starr Jordan, he took rank with the first. To show that he was indefatigable, we have only to state that he donated two large collections, numbering thousands of specimens each, one to Pomona College, the other to the National Museum of Washington. The one at Pomona numbered above one hundred thousand specimens of plants, and nearly as many specimens of insects.

"Professor Baker gave special attention to the entire orders, Hemiptera, Hymenoptera, Mallophaga, and Siphonaptera. It was said of Agassiz that he had a wondrous knowledge of the entire animal kingdom. With equal truth this could be said of Professor Baker, and his acquaintance in the plant world is hardly less remarkable.

"The Pomona College Journals of Entomology and Botany owe their existence and excellence alike to Professor Baker. How he could perform this admirable service and not neglect his other most arduous duties, passes understanding. These journals won attention and praise from nearly every country of the world.

"The Laguna Beach Biological Laboratory work in the summer of 1911, and the published volume of the results, is surely a unique example of what a master can accomplish. All of the workers were either those just graduated from college, or still undergraduates, and yet, the excellence and high character of this original research work is receiving commendation from many of the first scientists of the country.

"A genius, without the will to work, is still impotent, in the realm of achievement. Professor Baker's greatest peculiarity was his indefatigable and persistent habit of hard work. Early and late—very late—he would be found at the laboratory, turning off work in a way that was contagious, so that even the slothful pupil brought under the spell of his untiring application, often developed into a hard student. This is why his inspiring companionship wrought so powerfully and well, and why his going brings the deepest regret to all who knew of his inestimable service and influence."

A. J. Cook.

Professor Baker took up his work in Los Baños near the end of August, 1912.

An Economic Study of Beans

Seven Species, Nine Varieties

By Edgar M. Ledyard, B. S. A.

Thesis presented for graduation from the College of Agriculture. No. 9.

The markets of the Philippines are very poorly supplied with protein or fat foods of either plant or animal origin. Local meat products are scarce, high in price, poor in quality, and in many cases the animals from which these products are obtained have been raised under such unsanitary conditions that they are unfit to be eaten. With restrictions upon the importation of live stock, with the heavy refrigeration expenses connected with the importation of dressed meats, and with a scarcity of draft animals to carry on the work of farming, the relief to be afforded by the use of animal food seems to be remote. The raising of plants rich in protein will help to solve the food problem, as plant protein will take the place of animal protein in metabolism. Furthermore some of the proteid food plants are well supplied with carbohydrates and fats—thus furnishing in themselves a nearly balanced ration.

As a substitute for meat products it is necessary to select some group of plants that approximates them in composition, and such a group will be found in legumes. Dried legumes approach animal products in percentage of protein, and, in the amount of nutrient that can be bought in the markets of the Philippines for an equal sum of money, the legumes rank far above them. Of all the legumes used for food, beans are the most important since they are the most productive as well as the most nourishing. Beans are at once a source of food for the table of the grower, for the local market and for exportation. More remotely and indirectly they are valuable in furnishing the raiser of domestic animals with a correct fattening ration, by the use of which meat products may be supplied to the markets on a sanitary and economical basis.

Many tracts of land in the more thickly settled portions of the Philippines have been cultivated for hundreds of years without alternation of crops. As a result of this impoverishing cultivation the soil in such places has become exhausted, therefore these lands, which in many cases are close to easy means of communication, are being abandoned or but little used. It is possible, however, to reclaim such land. The use of beans for such a purpose is the best possible procedure.

Domestic science teachers have emphasized the lack of variety in the "every day" food of the common people. The growing of beans would help to overcome this lack, for beans may be used at different stages of their growth in a variety of ways, and the mature beans may be combined with other food products to make numerous nourishing and palatable dishes.

The use of a food rich in nitrogen in treating cases of beriberi is quite well established. The prevalence of beriberi where a number of men are placed in the same quarters is believed to be due to a lack of nitrogen and phosphorus in the rations issued to the men. Many health officials consider beans to be both a remedy for and a preventative against beriberi.

There are, to be sure, a few sources of animal food products and protein plant products in the Islands. Fowls,

fish and game supply a limited quantity of the first named products, but poultry husbandry is not more than a haphazard occupation at present in the Islands and the supply of fish is steadily decreasing as is also the supply of game.

Of the legumes there is only one, the *mungo*, that is in general cultivation and use throughout the Islands. The *mungo* is cultivated quite extensively in some provinces and mungoes can generally be obtained at the larger center. The *sitao*, *patani*, *batao*, *caguios*, *calamismis* and *daluyduy* (or sword bean) are cultivated locally. The *sitao*, *patani*, *batao* and *calamismis* are generally raised around houses, in small gardens or along fences. The *caguios* is grown mostly by people living on or cultivating lands in the mountains. The *daluyduy*, or sword bean, while well distributed throughout the Islands is but little cultivated except in Masbate and Mindoro. The *mungo* (*Phaseolus radiatus*, Linn.), *batao* (*Dolichos lablab*, Linn.) and *daluyduy* (*Canavalia* sp.), called also the "sword bean", "overlook", or "patagonian bean" have not been used in doing the present piece of work.

It will be seen that the general cultivation of beans at the present time in the Philippines narrows down to one kind, the *mungo*. This is not at all surprising with a people who are just starting diversified farming, particularly since the production of dried beans on a commercial scale is an industry of recent origin. The first record of raising dried beans in the United States for anything but home consumption dates from the year 1839 when thirty bushels were purchased by a dealer in western New York and shipped east.[1] From this small beginning the bean industry grew very slowly until the time of the Civil War when the production of dried beans became much larger to meet the demand of the Federal Government for an army ration. The soldiers learned to like the dried beans, and after returning to their homes they began to raise beans for their own use and for shipment to other places. From this time on the bean raising industry grew rapidly. A further use was found for beans when the canning of dried and green beans became established industries.

Until it was learned that the soy bean was important as an oil producer and as a soil renovator its production was confined to the same localities where it has been raised for thousands of years. Soy beans are now being raised in Europe and the United States and the industry is spreading to all parts of the world. The soy bean has spread rapidly in India since its introduction. It is in demand by people belonging to certain religious sects who prefer to eat plant rather than animal fats.

It is not the purpose of this paper to point out methods for increasing the cultivation of beans in the Philippines, but rather to discuss the manner of growth and cost of raising a number of different kinds, to indicate the ones that are believed to be best adapted for general use in the Islands and to give some of the uses of beans and bean products.

The species which were raised in doing this work will be discussed in the following order:

Psophocarpustetragonolobus, (Linn.), DC.,
Phaseolus vulgaris, Linn.,
Phaseolus lunatus, Linn.,
Centrosema plumieri, (Turp.), Benth.
Cajanus indicus, Spreng.,
Vigna unguiculata, (L.), Walp.,
Glycine hispida, (Moench), Maxim.

The botanical determinations have been made by Prof. Elmer D. Merrill, Chief of the Department of Botany in

(1) Stone, Cyclopedia of American Agriculture, Vol. II, Crops, p. 206.

the University of the Philippines and Botanist of the Bureau of Science, Manila. F_1 plants have been placed in the collection of the College of Agriculture and P (parent) and F_1 (first generation) seeds have been given to the Department of Agronomy.

The analyses of the different beans, unless otherwise given credit for, have been made by Dr. Deming, Associate Professor of Chemistry in the College of Agriculture.

The work has been done under the direction of Dr. Copeland, Dean of the College of Agriculture and Professor of Plant Physiology.

In addition to the above named my thanks are due Prof. Baker, Chief of the Department of Agronomy, Mr. Cuzner, Assistant Professor of Agronomy and Dr. Foxworthy, Assistant Professor of Dendrology who have given me aid and suggestions. Mr. Durham, Instructor in Animal Husbandry, has kindly placed at my disposal a number of bulletins on forage crops and the feeding of animals.

Psophocarpus tetragonolobus, (*L*), *DC*.

The *calamismis*, as this plant is called by Tagalogs, is found cultivated in parts of India and Malaya. The *calamismis* is also called *segidilla*, *cigarrillo*, *amale*, *pallam*, *pallang* and *camaluson* in the Philippines and Guam. In India and Ceylon it is known under the names of *daradhambala*, *chari-koni-seem* and *chevaux-de-frise*. Merrill in his Flora of Manila calls the *calamismis* the asparagus bean, but it is more commonly referred to by other writers as the Goa bean. Watt in his Commercial Products of India and Cameron in Firminger's Manual of Gardening, fifth edition, use the term asparagus bean as synonymous with cow pea. Merrill states that the *calamismis* is "certainly introduced." Thus excluding *P. tetragonolobus* which has been introduced and *P. palustris*, Desv., reported by F. Villar, which is not sufficiently well established, there is no native form of *Psophocarpus* in the Islands.

Nearly all the writers referred to in doing this work have remarked on the appearance of the pods of the *calamismis* which they have termed as "four-sided," "frilled," "winged," etc. While the character of the pods is sufficient to identify the *calamismis* among Philippine beans, a botanical description is given for those who wish a detailed description. "*Psophocarpus tetragonolobus*, (L.), DC.

"A glabrous, twining, annual vine reaching a length of 6 m. or more. Leaves 3-foliolate, leaflets ovate, entire, acuminate, 8 to 14 cm. long, base deltoid. Racemes few-flowered up to 15 cm. in length. Flowers light-blue, 3 to 3.5 cm. long. Pod square, 10 to 20 cm. long, about 2 cm. thick, 4-winged, the wings about 5 mm. wide, crisped. (Fl. Filip. pl. 293.)" Merrill, A Flora of Manila, 1912, page 264.

All of the beans that were cultivated in doing this work were grown on a piece of land that lies across the College road from the botanical and chemical laboratories. The land slopes gently downward to the east. The soil, which is a rather heavy clay, is the same throughout, but the plots differed somewhat in character on account of differences in their histories. History, as here used, is a record of a plot during the past four years. Nothing is positively known about the use of the land previous to this time. On the north of the tract of land, set aside for bean culture, is a wood lot; on the south a row of rubber trees. Neither of these interfered to any great extent with the light or the wind. Parts of the bean area were covered with small trees and brush, which were cleared off and carried away, and not burned

on the ground as is the usual custom. No fertilizers were used on any of the plots.

The land upon which the *calamismis* was grown has been under cultivation more or less irregularly during the four years of the existence of the College. A number of different crops have been raised on the land, among them egg plants, bananas, corn and papayas. The heavy grass and light brush were removed from the plot and plowing began in the latter part of June. The land was plowed twice in June and allowed to lay fallow until the latter part of August when it was harrowed with a spike-tooth harrow. Early in September the bean area was cultivated with a wheel cultivator and again harrowed. The ground was not in first class shape when the beans were planted on the 16th of September, 1912, but it was thought best to begin the planting at that time in order that the work might be finished before the close of the school year.

Two varieties of the *calamismis* were raised. They were called the large variety and the small variety. (These terms are relative and refer only to the seeds at hand as a complete collection of *calamismis* seed was not available for comparison.) The beans were taken from the seed room of the Department of Agronomy and were known on the records as No. 207 F_1.

Ninety eight *per-cent* of the seeds that were planted germinated. The seeds of the large variety were reddish brown and nearly round. The seeds of the small variety were of the same shape as those of the large variety but were smaller and darker in color. The seeds of both varieties were much lighter in the F_1 stock (present work) than in the P stock. The weights of the large variety were as follows:

Largest dry seed.....0.334 g.
Smallest dry seed.....0.314 g
Average (11 beans).....0.328 g.

Small variety:
Largest dry seed.....0.203 g.
Smallest dry seed.....0.138 g.
Average (11 beans).....0.178 g.

The seeds of both varieties were planted with a hoe and three seeds were placed in each hill. The hills were 50 cm. apart in the rows and the rows were 50 cm. apart. A hoe was used rather than a hand planter as better results could be obtained. A check-rower was not available. In doing the planting the stones and clods were removed from the hill and the grass roots removed by striking two or three blows with the hoe.

Planting with a hoe is only one-third as fast as planting with a planter. A man can plant about one hektare of land in a day with a hoe if the hills are one meter apart each way, and the ground is in good condition.

The beans appeared above the ground on September 24th, about eight days after they were planted. Owing to the cloudy and rainy weather that prevailed during September, October and a part of November the plants did not make a rapid growth at first. The beans were poled about the middle of October. Bamboo stubs about two meters high were placed in the ground and on these uprights a trellis of split bamboo was placed. Split bamboo pieces about two meters long, one centimeter thick and three centimeters wide were stuck in the hills and connected with the trellis at the top.

The first blossoms appeared on the 20th of December. Several messes of the young pods were eaten during January and found to be very palatable. The first ripe beans were gathered on February 21st, 1913. The dried beans

were cooked and found to be more palatable than the Lima beans, that were raised on the same arbor and discussed elsewhere in this paper, but were not so good as the regular garden beans or the native *sitao*. Among the Filipinos the young pods are eaten but the dry seeds are rarely used except for planting. The newly harvested beans of both varieties were weighed and found to run as follows:

Large variety:

Largest new seed	0.414 g.
Smallest new seed	0.349 g.
Average (100 beans)	0.370 g.

Small variety:

Largest new seed	0.224 g.
Smallest new seed	0.156 g.
Average (100 beans)	0.196 g.

It will be seen that the new seeds varied more in weight than the old seeds.

There were on an average eleven beans in a pod and eight pods to a vine (large variety). There were three vines to each hill. Since the beans were planted in hills 50 cm apart each way, it will be seen that the calculated yield for one hektare of the large variety is as follows:

(a) 40000 hills,
120000 vines,
960000 pods,
1560000 beans.

As these beans weighed on an average 0.370 g. each or a total of 577.2 kilos.

When sold to the consumer these beans would bring ₱57.72 at current prices.

The cost of raising and marketing one hektare of these beans on the farm of the College is calculated as follows:

Upkeep of land (6 months)	₱2.00
Plowing	6.00
Harrowing and marking	4.50
(b) Planting with hoe	6.40
Cultivating and hoeing	4.60
Bamboo for poling	72.00
Poling	48.00
Harvesting and marketing	28.00
Clearing away bamboo	4.80
	₱176.30

In making the table of expenditures the price per day for a man, a carabao and a plow is figured at ₱1.50. The price of day labor is figured at ₱.80 per day.

There would be a calculated loss of ₱118.58 per hektare in raising these dry beans for the market and disposing of them readily. On the other hand, if the young pods were sold there would be a profit calculated at ₱2181.70 per hektare. In making this computation ₱120.00 is allowed for harvesting and marketing (rather than ₱28.00) and ₱150.00 for getting the produce to market (freight charges.) The other items would remain the same. *Calamismis* pods are usually sold at the rate of six for one centavo to the retailer and at the rate of three for one centavo to the consumer.

The raising of the small variety is less profitable than the large variety as the pods only averaged six to the vine. The seeds were also considerably smaller. The small variety is raised, however, in many places, as it is more palatable than the large variety. The pods of the large variety averaged 21 cm. in length and the pods of the small variety averaged 12 cm. in length.

Macmillan, in a Handbook of Tropical Gardening and Planting, states that in Burma the Goa-bean is largely cultivated for its fleshy tuberous roots which are said to yield from 1¼ to 2 tons per acre. It has also been stated that this bean is grown in Cochin China for its tubers and that they are an important product.

(a) Disregarding the 2% that did not germinate.

(b) Ground not in good condition for fast planting.

Nothing was found in the literature of the College on this point, except what is stated by Macmillan. (The big crop of both Burma and Cochin China is rice.) While a number of other agricultural products of minor importance are listed in the latest editon of the Encyclopaedia Britannica for Burma and Cochin China the *P. tetragonolobus* is not mentioned.

A number of the tubers that grew on the plots were gathered and of both varieties the largest was found to weigh (green) 37 grams and the smallest 5 grams. The average of 100 tubers was 22 grams. Allowing three to a hill there was a yield of 2640 kilos to the hektare. Macmillan states that where the tubers are grown as a product the seeds are not allowed to ripen, whereas the tubers that were weighed in this work were taken from plants with mature seeds. It should also be noted that the *calamismis* beans were raised on the north side of the arbor and were somewhat shaded by the vines of the Lima bean growing on the south side. Again, the soil, as mentioned before, was a rather heavy clay and not the best suited to the production of tuber crops.

Cameron, in Firminger's Manual of Gardening (India), says, "Though as a vegetable of little value, the plant is well worth a place in the garden, being ornamental for the large blue flowers it bears in the cold season, as well as for the effect of its curious pods hanging upon it." Macmillan says, "They are cooked when green, and usually much relished." Stafford, in Useful Plants of Guam, says, "The green pods of this plant are eaten in Guam as a vegetable. They are tender, free from stringiness, and of excellent flavor. The tuberous root is edible, but is not utilized in Guam. In India the pods are used in pickles and the seeds are eaten." Gollan, in Indian Vegetable Garden, says, "It is a common plant in the warmer parts of India but not often met with in the Northern Provinces. It grows freely but bears rather sparingly, and is therefore not a desirable variety for cultivation in this part of the country."

While the figures obtained in this experiment would seem to indicate that the *calamismis* would be a very profitable plant to raise for its pods, the results obtained in raising the *calamismis* on a large scale might be very different, owing to factors that might enter. The pods are very perishable and would have to be marketed at once. It is not at all certain that a market could be found for a large amount of these pods. The labor that would be required to carry on the work might not be available for a short period. There would be required a heavy initial expense and not every gardener or farmer is in a position to make such an advance. If the advance were made by a money loaner a large part of the profits would go to him.

The principal use of the *calamismis* at present seems to be as a supplementary garden vegetable.

In the works consulted no analyses of the *calamismis* were found and the following have been made by Dr. Deming.

Large variety:

(new dried beans)

Moisture	*Protein* $N \times 6.25$	*Oil*	*Ash*	*Other constituents, (chiefly carbohydrates)**
%	%	%	%	%
9.55	29.75	11.60	6.55	42.73

Small variety:.

(new dried beans)

Moisture	*Protein*	*Oil*	*Ash*	*Other constituents (chiefly carbohydrates)*
%	%	%	%	%
9.80	28.28	18.50	4.65	38.77

*Of the total carbohydrates 8.8% (*P. mungo*) are crude fibre. It is presumed that the other legumes will run about the same.—Note by Dr. Deming.

Phaseolus vulgaris, Linn.

Two lots of white beans were planted and harvested in doing the present work.

The beans of the two lots were alike in shape and color but differed in sizes. They were furnished by the Department of Agronomy of the College of Agriculture. These beans were obtained in Pakhoi, China, by Forester Hugh M. Curran, formerly Associate Professor of Forest Management of the College. Mr. Curran selected the seeds from a number of lots in the market of the above named city, and it is not known whether the difference in size was due to selection or to grading. The Chinese, like the American dealers, often grade their beans carefully, for they not only make a better appearance when graded to size, but they also cook better if uniform. As neither lot bred true it is more than probable that they were graded beans, although a change in the environment might account for the differences.

The common white bean is now grown all over the world where the climate is warm enough to permit it to be raised. It is not known where the common white bean originated, but Stone, in Cyclopedia of American Agriculture, considers it to be a native of the New World. His opinion is supported by many other writers both botanical and agricultural. There are seven or eight varieties of commercial white beans grown in the United States, and some of these varieties have several sub-varieties. Commercial white beans have been grown by the writer and by many other Americans in the Philippines for several years for use as string beans. The Chinese gardeners cultivate the white bean near Manila for the markets of that city. While the white bean is probably well known to most people a botanical description is given for the sake of completeness.

"*P. vulgaris*, L.

"An annual nearly glabrous or lightly hairy, erect, branched plant, or a slender twining vine. Leaves 3-foliolate, the leaflets ovate, acuminate, base rounded, 7 to 11 cm. long, the lateral ones inequilateral. Racemes axillary, few flowered, shorter than the leaves, the pedicels longer than the calyx. Flowers white, turning straw-colored or somewhat pink-purplish, 1.5 to 2 cm. long. Bracteoles ovate, green, persistant. Pods linear, somewhat curved, 10 to 15 cm. long, about 1 cm. wide."—Merrill, A Flora of Manila, 1912, page 261.

The preparation of the ground for the white bean was the same as for the *calamismis*. The ground, however, upon which the white beans were raised was covered with quite a growth of brush which had not been removed during the occupancy of the land by the College. The beans were planted on the 16th of September and appeared above the ground in five days. Three beans were placed in a hill. The hills were 30 cm. apart in the rows and these were 90 cm. apart. Only 82 *per-cent* of the seeds that were planted germinated. Most of the failures were due to the beans rotting in the hills. The beans were cultivated three times with a wheel cultivator and were hoed twice. These beans and all the others, with the exception of the Centrosema, were kept in rather better condition than are the beans grown by Filipinos.

The first flowers appeared thirty days after planting. The flowers on the different plants and on different parts of the same plants appeared very irregularly. It was frequently noted that mature seeds and flowers were found on the same plants simultaneously. In this respect they varied greatly from the soy beans which matured very evenly. The first mature beans were gathered on November 25th.

In spite of the fact that the beans were visited daily, many of the pods containing mature beans rotted. The

beans were spoiled in the pods by gathering moisture from the ground or by the moisture contained in them. The superiority of pole-beans over bush-beans in countries where there is much rainy weather is apparent from these results. After the dried beans are gathered great care must be exercised or they will mould while in storage. It would also seem to be desirable to select beans with thin pods for use in tropical countries.

The F_1 beans were planted on January 16th but did not thrive after the first week of their growth. They were planted on the same plot as were the P beans. The leaves wilted and the beans presented a sickly appearance. Specimens of the diseased beans were shown to Professor Baker who examined the plants and said that they were affected by a root disease. None of the F_2 plants survived.

During the time that this experiment was going on the writer raised a number of different kinds of beans on another part of the College farm. Among the kinds raised were common white beans. When these beans became ripe a number of Filipinos were offered one half of the crop for harvesting them. After a few had worked for a day or two, no one made any attempt to avail himself of the offer. The Filipinos stated that they lacked facilities for drying the beans and they would only mould later.

The weights of the large variety were as follows:

Largest old bean.....0.398 g.
Smallest old bean.....0 284 g.
Average (100 beans)...0.368 g.

Small variety:

Largest old bean.....0.165 g.
Smallest old bean.....0.126 g.
Average (50 beans)....0.149 g.

The weights of the newly harvested were as follows:

Large variety:

Largest new bean.....0.414 g.
Smallest new bean....0.238 g.
Average (100 beans)...0.392 g.

Small variety:

Largest new bean.....0.233 g.
Smallest new bean....0.124 g.
Average (100 beans)...0.156 g.

By computing it was found that the yield per hektare of dried beans* was 636 kilos. The value of this crop was calculated at ₱47.70, as dried beans can be sold to retailers in Manila at ₱0.075 per kilo. It would be impossible with present facilities to compete with bean growers in America in raising dried white beans. Most of the dried beans sold in Manila are raised in Michigan, New York, California or Canada. While labor is higher in those places the beans are planted, harvested and threshed by machinery and rotting in the pods or in storage does not often have to be contended with.

The principal use of the white beans in America is for culinary purposes. Formerly beans were harvested and fed to stock, but the price of beans at present does not allow such a use. Cull beans are bought by stockmen and fed to sheep and other animals.

Most of the dried white beans that are consumed in the Philippines are used by Europeans and Americans. Nearly all of these beans are imported either from Spain or America. White beans are used in making soup and are also used as boiled beans and as baked beans.

The principal use of the white bean in the Islands at present is as a garden vegetable. On account of the competition with other beans that have been carefully selected for garden raising (such as the Canadian Wonder, French Dwarf, etc.) and with the *sitao* and other native beans, its use is restricted. It

*Large variety.

is better to buy seed than to attempt to gather it from plants raised. Not more than one or two crops should be raised on the same plot of ground as white beans are very susceptible to root diseases.

Analysis of Cull Beans.*

Water	*Protein*	*Fiber*	*Nitrogen free extract*	*Fat*	*Ash*	*Refuse mostly gravel*
%	%	%	%	%	%	%
10.00	21.60	3.70	47.50	1.20	3.20	12.80

Digestible Nutrients in Bean Straw.*

Total dry matter	*Protein*	*Carbohydrates (fat ×2¼)*	*Total*	*Nutritive ratio*
%	%	%	%	%
95.00	3.60	39.70	43.40	1 : 11.0

*Cyclopedia of American Agriculture, Volume II, Crops, page 210. Article by J. L. Stone.

Phaseolus lunatus, Linn.

The Lima bean, called by Tagalogs the *patani*, has been credited with three places of possible origin. These places are the East Indies, Africa, and South America. Of these places the one now most generally agreed upon is South America. Lima beans have been found with the bodies of mummified Incas in Peru and the Lima bean grows wild there. Professor Bailey, of Cornell University, has suggested that the name was taken from Lima, the capital of Peru. While Lima beans have been raised in Europe for more than three hundred years, it is in America that the cultivation is carried on most extensively. The State of California is the pioneer and leader in the Lima bean industry in the United States. Lima bean raising as an industry started in that state about the year 1871. Practically all of the cultivated varieties grown in the United States have originated there. The Lima bean grown in California as a field crop and in the East as a green shell bean crop is uniformly white. A few dealers list varieties which are red, speckled or black, but these varieties are rarely seen in cultivation in the United States. In the eastern part of the United States both the pole and the bush Lima bean are raised. The Lima bean grown in California is of the bush variety and it is planted, harvested and threshed by machinery in much the same way that the common white bean is handled.

The Lima bean grown in the present experiment was obtained from the Department of Agronomy, but its history is not known.

Lima beans are classified according to their habits of growth as pole Limas and bush Limas. The seeds of both pole and bush Limas are divided according to the size and shape into three classes which are as follows:

(1) Large flat Limas,
(2) Large thick Limas,
(3) Small flat Limas.

The large flat bush Limas are raised almost exclusively in California. The large thick pole Limas are generally raised by Filipinos. The seeds that were planted in doing this work were of the third class. A botanical description of the patani follows:

"*P. lunatus*, L.

"A scandent, slender, annual, glabrous or sparingly pubescent, herbaceous vine reaching a length of 4 m. or more, the stipules small, basifixed. Leaflets ovate, acuminate, thin, 6 to 12 cm. long. Racemes axillary, solitary, peduncled, 8 to 20 cm. long. Flowers long-pedicelled, about 13 mm. long, the calyx pale-greenish, the corolla much longer than the calyx, greenish or pale-yellowish. Pods oblong, somewhat curved, 6 to 12 cm. long, about 2 cm. wide, containing from 1 to 4 large, variously colored or white seeds." (Fl. Filip. pl. 352, 369.) Merrill, Flora of Manila, 1912, page 261.

The *patani* and the Goa bean were raised on the same arbor for convenience.

The preparation of the plot for the *patani* was the same as that for the Goa bean. As before noted the *patani* had the advantage over the Goa bean on account of the fact that it grew on the south side of the arbor. The cultivation and general treatment for both were the same. The seeds were planted on September 16th, 1912, and the beans appeared above the ground six days later. The flowers were first noted on December 5th and the first mature beans were gathered January 27th, 1913. Three seeds were planted in a hill. 92 *per-cent* of the seeds planted grew. The hills were 50 cm. apart each way. The average number of pods to the vine was 40 and the average number of seeds to the pods 4. The weights of the old and new seeds, P and F_1 were as follows:

Largest old seed	0.482 g.
Smallest old seed	0.298 g.
Average (20 beans)	0.334 g.
Largest new seed	0.510 g.
Smallest new seed	0.198 g.
Average (100 beans)	0.365 g.

It will be seen that the new seeds varied more in weight than did the old seeds. The yield per hektare calculated at 7008 kilos. Most of the *patani* marketed are sold as green shell beans and the usual price to the consumer is eight centavos a kilo and to the retailer four centavos per kilo. The market value of one hektare of Lima beans yielding as above is ₱280.32. In computing, the price of green shell beans is fixed at ₱.04 per kilo.

The green shell beans of this *patani* were cooked, but they could not be eaten on account of their bitter taste.

The shape of the F_1 beans was quite like that of the P beans. The color of the P beans was dark-brownish red. The colors of the F_1 beans ranged from purplish black with a very few cream colored spots, through deep-purple spotted to cream colored. The color feature of Lima beans has caused a great deal of discussion on account of the poisoning that has been caused as a result of persons and stock eating the dark and speckled kinds. It is generally believed among investigators that the dark and speckled kinds contain a cyanogenetic glucoside known as phaseolunatin. Phaseolunatin is not confined to Lima beans but it has been found in the roots of the cassava plant and in the stems, leaves and seeds of the common flax. The attention of the authorities of the Government of the Philippines has been called to cases of poisoning that have occurred from people eating "wild beans." Dr. Foxworthy informed the writer that he was called upon to identify some beans that had caused the death of a family in Bohol in 1907. The beans were identified by him as *P. lunatus*. He spoke of this case of poisoning to Colonel Prain of India, who stated that his observations had been that such cases in India had usually been caused by people eating the dark and wild varieties.

The following is quoted from the Bulletin of the Imperial Institute, Vol. I, pages 112 and 113:

"Poisonous Fooder Plants and Food Grains

Phaseolus lunatus.

"The investigation of the Phaseolus lunatus has now been completed, and a paper embodying the principal scientific results of the work has been communicated to the Royal Society by Professor W. R. Dunstan, F. R. S., Director of the Imperial Institute, and Dr. T. A. Henry, and has been printed in the proceedings of the Royal Society.

"Phaseolus lunatus is believed to be indigenous to South America, but it is now generally grown throughout the tropics for the sale of the seeds which,

as obtained from the cultivated plant, are employed as a vegetable. The plant itself has the general habit of the scarlet runner (*Phaseolus multifloris*) to which it is closely related. In a wild state it produces seeds which vary in color from light brown to deep purple, whilst under partial cultivation the seeds are usually light brown or pink with a few purple spots, and when thoroughly cultivated they become larger and the color changes to a pale cream tint. Coincident with these changes of color in the seed coat the toxicity of the seeds decreases with cultivation. In Mauritius the plant is grown practically wild for use as green manure, since it shares with other leguminous plants the power of utilizing the nitrogen of the air, and is therefore a cheap source of nitrogenous manure. The seeds, however, are markedly poisonous, and great care is taken to prevent cattle from eating them. In India, Burma and the Straits Settlements, and other tropical countries where *Phaseolus lunatus* is partially cultivated, the pink or brown seeds are commonly eaten, but instances of poisoning by such seeds have been recorded, and attention has been directed by Mueller (Select Extra Tropical Plants) and by Watt (Dict. Econ. Prod. Ind. Vol. VI, p. 186) to the necessity of using only light colored seeds and rejecting as possibly poisonous those bearing much of the purple coloration. In the case of the white seeds, known in commerce as 'Lima or Duffin beans,' furnished by the commonly cultivated plant no cases of poisoning have been recorded." Pages 114 and 115 same. "In all these cases the two constituents of the plant which react with each other are respectively a glucoside and an enzyme (unorganized ferment). Preliminary experiments showed that the seeds liberated prussic acid in the course of a few minutes after being crushed and moistened with water. Determinations were made of the amount of prussic acid obtainable from the seeds in this way, and it was found that it varied with the colour of the seed—very light brown seeds furnishing about 0.04 per cent and the deep purple seeds as much as 0.08 per cent.* * * *The toxicity of these seeds must, therefore, be attributed to the formation of prussic acid as the result of the decomposition of the glucoside* PHASEOLUNATIN *by the enzyme* EMULSIN *in the presence of water.*"

In Volume IV of the Bulletin of the Imperial Institute, published in 1906 three years later than Vol. I, there is a table of analyses of *P. lunatus* which is in part reproduced here.

The results of more recent investigators indicate clearly that phaseolunatin is gradually eliminated from Lima beans by cultivation. Lima bean bulletins written in the United States contain no references to cases of poisoning from the white lima beans cultivated there. The small "haricot beans" grown in Rangoon yield an exceedingly small *per-cent* of prussic acid and the small "haricot

Origin and colours of beans.	*Dunstan & Henry. Pru. acid*	*Guignard Pru. acid*	*Kohn-Abrest. Pru. acid*	*Tatlock and Thomson. Pru. acid*
JAVA				
Mixed beans, all colours	0.038—0.0116	0.052—0.102		0.027—0.137
Cream white	0.105—0. 110	0.052	0.037	0.027
MAURITIUS				
Purplish white	0.088			
BURMA				
Pale brown with purple spots	0.004—0. 008	0.011		
Cream white	nil	0.006		
MADAGASCAR				
White		0.008		

beans" raised in Chili yield none. Both of the above named have been cultivated for a long time.

The table given above shows quite a per-cent of prussic acid in some of the cream white beans. These beans which are wild ones are not to be confused with the white cultivated beans. Mr. Dacanay, a student of the College of Agriculture, has this season raised a number of beans similar in form to those raised by the writer. The beans he raised are, however, uniformly white and are edible. His beans are known as "white patani" and are supposed to have come from cultivated stock in Iloilo.

It is believed by many people that Lima beans when cooked thoroughly (parboiled) are no longer poisonous. On that point a writer on Cyanogenesis in Plants, in Vol. IV, Bulletin of the Imperial Institute, has the following: "It has been found at the Imperial Institute that by soaking the beans in cold water over night, and then boiling them in water until they are soft, practically no change in the amount of phaseolunatin takes place, but the cooked beans when broken up in water do not yield prussic acid, since the enzyme has been destroyed in the cooking process, and is no longer available to decompose the glucoside. It must be remembered that though such cooked beans no longer yield prussic acid when mixed with water, it does not follow that they are not poisonous, especially to herbivorous animals, since there is always the risk of the cooked beans being fed to the animals along with other vegetable material containing an enzyme capable of decomposing the phaseolunatin present in the cooked beans, even if there should be no intestinal enzyme capable of decomposing the glucoside."

The principal use of the *patani* in the Philippines at present is as a green shell bean. Filipinos prepare the *patani* by removing and skinning the seeds which are parboiled and eaten entire or mashed. While the pole *patani* is fairly successful as a "side garden product" to be raised commercially a bush variety would have to be introduced. With this bush variety there would be need of improved machinery for planting, harvesting, and threshing. Users of *patani* should buy only the cultivated varieties for culinary purposes. Stock should not be allowed to eat the wild varieties. It is doubtful whether the pole *patani* can be successfully raised as a forage crop on account of the expense in cultivating it.

ANALYSIS

(new dried beans)

(Pink variety)*

Moisture	*Protein* $N \times 6.25$	*Oil*	*Ash*	*Other constituents, (chiefly carbohydrates)*
%	%	%	%	%
15.85	14.84	1.30	3.65	64.36

Centrosema plumieri, (Turp.), Benth.

The writer has not been able to find a Filipino name for this legume. While many people who have been interviewed have apparently recognized the plant, none of them have mentioned a distinctive name for it. The attention of an observer would be called to the plant by its showy flowers and by its pods which when young are strongly compressed along their longitudinal central portions. The young pod is so thin along this central portion that when held between the eye and an illuminant a streak of light may be seen. While the pod must be seen to get an idea of its peculiar shape, the following measurements obtained from a young pod taken from a plant March 1st, 1913, the seed of which was planted on September 16th, 1912, will help one to form an idea: Length of pod, 11 cm.; average width of pod, 11 mm.; thickness of the pod on either side of the depressed portion, 5 mm.;

*A mixture of the ones raised.

thickness of the depressed part, 2 mm. The central depressed portion occupies about one third of the surface of the pod.

The newly formed seeds in the young pods lie on the concave side, but as they grow older they force their way quite to the center and occupy the main part of the interior. The young pods are small and fibrous compared with the pods of the *calamismis*. The form and structure of the pods are factors in determining the usefulness of this plant. The fibrous character of the pods make them unfit to be eaten when young and mature pods are difficult to "thresh" as the seeds adhere tightly to the pods which are not easy to rupture. Merrill states, in "A Flora of Manila," that the Centrosema is "now spontaneous in Malaya". A number of books were consulted, but the Centrosema was not included as a product of importance by the writers. The Centrosema is not commonly used as a food plant by Filipinos. A botanical description follows:

"*C. plumieri,* (Turp.), Benth.

"A twining, herbaceous vine, from a woody base, reaching a length of 5 m. or more, glabrous or nearly so. Leaflets ovate, shortly acuminate, 5 or 15 cm. long, entire. Racemes axillary, solitary, few-flowered. Flowers 4 to 5 cm. long, white, the center magenta. Pods 10 to 15 cm. long, about 1 cm. wide, long-acuminate, prominently longitudinally 2-ribbed along each valve. (Fl. Filip. pl. 455, Clitorea plumieri.)" Merrill, Flora of Manila, 1912, page 258.

The seeds that were planted in doing this work were obtained from the seed room of the College of Agriculture and were known on the records of the Department of Agronomy as 197 F_1. The seeds were planted on September 16th, 1912. Three seeds were placed in a hill. The hills were 60 cm. apart in the rows and the rows were 90 cm. apart. Only 22 *per-cent* of those planted germinated. This loss was not by hills but by areas, thus large patches of the ground were left bare at first. While the rotting of the seeds, due to being planted too deep, was the cause of the failure in some cases it does not account for the entire loss. The plots where the Centrosema was planted was somewhat wooded. Clearing was accomplished without burning and the soil was infested with termites and ants. Immediately after the plants appeared an examination of the vacant hills was made and nothing was found in many of them. From this it was inferred that the seeds had been eaten or carried away by the above named pests. The plants grew slowly at first and it seemed that they would not cover the ground. Later it was found that if the 22 *per-cent* had been well distributed it would have been sufficient to make a good cover crop. In places where the germination was good the plants were entirely too thick. The plants showed an ability to overcome other plants. The plants were cultivated once and hoed once. Cultivation was a difficult task and was accomplished only by laying the vines on the "tops" of the rows and using care not to detach them with the cultivator. The first flowers appeared on January 5th and the first mature fruit was taken on February 27th. Owing to the irregular stand and the thickness of the vines which were "heaped" in places and could not readily be detached for counting the pods, a calculation for a hektare could not be made with accuracy.

The following is an approximately correct estimate:

18426 (plus) hills planted
22 *per-cent* grew, or,
4053 (plus) hills
12159 vines
194544 pods
1556352 beans.

The weights of the seeds were as follows:

Largest dry seed.....0.133 g.
Smallest dry seed.....0.119 g.
Average (100 seeds)...0.124 g.
Largest new seed.....0.153 g.
Smallest new seed.....0.132 g.
Average (100 seeds)...0.141
Calculation for a hektare 205 kilos.

The seeds were very uniform in appearance, and size. The P seeds were much darker than the F_1 seeds.

The young pods were cooked, but they were not palatable on account of their tough fibrous character. The mature beans were cooked and found to be fairly palatable.

The Centrosema is not used by Filipinos to any extent at the present time. This is probably on account of the length of time that it takes to mature, the amount of the space that the vines occupy, the lack of palatability of the young pods, the difficulty of threshing the mature pods and finally because it is not in general use and innovations in agriculture are slow. The seeds have good storage qualities as they are small and hard.

The Centrosema seems to have two uses. It might be cultivated as an ornamental plant. It might be sown broadcast as a cover crop and turned under. Owing to the nature of its vines it can be handled better with the native plow than can some of the other legumes. The luxuriance of its vines recommends it as a green manuring crop.

ANALYSIS.
(New dried beans)

Moisture	*Protein* N×6.25	*Oil*	*Ash*	*Other constituents (chiefly carbohydrates)*
%	%	%	%	%
19.50	14.88	0.70	4.42	60.50

CAJANUS CAJAN, (L.), MERR.

THE PIGEON PEA

The pigeon pea is called by the Tagalogs *caguios*. In Guam the plant is called *lenteha francesa*. In India it is known as the pigeon pea, *Pois d'Angole*, *dhol* or *dhal*, *tur*, *lahar*, *kanalu*, *etc.* In Ceylon the pigeon pea is called *dhol* or *dhal*, *rata-tora*, *thovaroy*, *paripu* by native agriculturists and Congo bean by Europeans. In Porto Rico it is called *gandul*. Safford (l.c., page 206) says, "It was introduced into Guam in 1772 by the French ship Castries, whence its local name, which signified "French lentil". Watt (l.c., page 196) says, "The pigeon-pea would seem to have been introduced into the West Indies (Griesbach, Fl. Br. West Ind., 191) and to America from Africa, and apparently through the slave trade. It has long been cultivated in India, but nevertheless no Indian botanist has recorded having found it wild, or even naturalized, so there would seem to be little doubt that in India it is an introduced plant. It is not mentioned in any of the early Sanskrit works. On the other hand several travellers mention having found it wild in Africa. In Madagascar it is an important and apparently very anciently cultivated plant." Merrill says (l.c. page 255) "Tropics of the World, probably a native of India."

Watt (l.c., page 196) says, "There are two forms of this well known pea, which by some authors have been viewed as species. They are apparently of independent economic value and hence may be here separately indicated:—C. bicolor, DC.

"This might be described as a large bush, 6 or 8 feet in height, according to Roxborgh, with a circumference of 20 feet around the extremities of its branches—in other words twice the size of the next form. The flowers are yellow streaked with purple, and there are four or five seeds in the pods, which are also marked with dark streaks. It is in reality a perennial, but from its yielding a poor

second crop, is in India usually treated as an annual.

"C. flavus, DC.

"This is a much smaller plant than the preceding. It has been described as having perfectly yellow flowers, and usually only two or three seeds in the pods, which are never spotted."

The plants that were grown in doing this work were, when mature, about 240 cm. in height, 360 cm. in circumference, and had yellow flowers. The seeds were both unspotted and spotted in the P stock. The seeds of the F_1 were quite similar in form and color to the seeds planted. A botanical description is given:

"Cajanus cajan (L.) Merr. (C. indicus Spreng.). An erect, branched, pubescent, shrubby plant 1 to 2 m. high. Leaflets 3, oblong- lanceolate, acuminate, 3 to 10 cm. long, grayish beneath when dry. Inflorescence axillary, of few- flowered, corymbose, peduncled racemes, 3 to 7 cm. long. Flowers yellow, about 1.5 cm. long. Pods 4 to 7 cm. long, about 1 cm. wide, pubescent, prominently acuminate, obliquely sulcate between the 2 to 3 seeds. (Fl. Filip. pl. 167.)" Merrill, "A Flora of Manila", 1912, page 255.

The seeds that were planted in the present work were taken from the seed room of the College of Agriculture. The seeds were from plants raised on the College farm. Three seeds were planted in a hill. The hills were 60 cm. apart in the rows and the rows were 90 cm. apart. The plants were cultivated twice and hoed once. 96 *per-cent* of the seeds planted grew, making a good stand. When the plants were about one meter high it was evident that they were too close and one plant in each hill was cut out. The two remaining plants quickly filled in the space left vacant by the plant taken out. Most of the plants blossomed about January 15th and the first mature seeds were taken on March 12th. The ripening of the seeds like the flowering was irregular and the crop was not ready to gather until the 25th of March.

The following is a calculation for a hektare of the pigeon pea:

18426 (plus) hills.
36852 plants.
13266720 pods.
79600320 seeds.

The weights of the seeds were as follows:

Largest old seed.....	0.102 g.
Smallest " "	0.071 g.
Average " "	0.092 g.
Largest new seed.....	0.120 g.
Smallest " "	0.098 g.
Average " "	0.111 g.

The calculation for a hektare of pigeon peas raised under conditions similar to the ones in the experiment is 8835.6 kilos. The dry beans only are used by Filipinos and the beans sell for ₱0.10 per kilo to the consumer and at ₱0.05 to the retailer. Taking the latter figures as a basis the value of the crop would be ₱441.78. This on condition that a market could be found for the beans.

Watt (l. c. pages 199 and 200) says, "In India the pulse is highly esteemed by the natives, who regard it as the third in rank of importance among the leguminous seeds. Sometimes the tender green pods with their contained peas are in India cooked in curry like French-beans. They constitute in fact an excellent vegetable much neglected by Europeans resident in India. Church (Food-Grains of Ind.) gives the composition of the husked pea as:—

Water.....	10.5
Albuminoids.....	22.3
Starch.....	60.9

Fat	2.1
Fiber	1.2
Ash	3.0
Nutrient ratio	1.3
Nutrient value	80.0

....The stalks are used as fuel, the larger ones being prized for the charcoal sold to makers of gunpowder." Macmillan (l.c., page 186) says, "It is commonly cultivated in most tropical countries, but more especially in India, where the dark gray seeds, of the size of small peas, are almost a universal article of food. Grown alone, the yield may be as high as 2000 lb. per acre, 500 lb. per acre being an ordinary return. Not commonly cultivated in Ceylon."

The pigeon pea is at present of no such importance in the Philippines as it is in India. The pigeon pea is cultivated mostly by people living in the mountains or by people cultivating *kaiñgin*. Many farmers in the southern islands raise a few plants as a supplementary vegetable, but it is not depended upon as a food plant. The young seeds were eaten and found to be quite palatable. The pods with the seeds were cooked and while edible the dish was not an attractive one. The young peas were very palatable. The pigeon pea might be used as a hedge to mark the limits of a garden. With plows sufficiently large to do the work it could be turned under as a green manure.

ANALYSIS.

(New dried beans)

Moisture	*Protein* $N \times 6.25$	*Oil*	*Ash*	*Other constituents (chiefly carbohydrates)*
%	%	%	%	%
12.20	24.38	1.75	4.65	57.02

VIGNA UNGUICULATA, (L.), WALP.

COW-PEA

The word cow-pea seems to be misnomer for the *V. unguiculata*. The Supervising Committee of the N. C. State Horticultural Society make the following statement, The Cow Pea, page 5: "The cow pea's botanical name is *Vigna sinensis*, and although commonly called a "pea" it is, correctly speaking, neither a pea nor a bean and differs widely from both. To be sure, they all belong to the same family (*Leguminosae*) but so do clovers, alfalfa and vetches." Stubbs, Dodson and Bird in Bulletin No. 40, second series, Louisiana Agricultural Experiment Station, page 1441, say, "The genera Dolichos and Vigna both belong to the section of Leguminosae to which true beans belong." Also on page 1440, "Why it was ever called 'cow pea' is also left to conjecture. One of its Hindoo or East Indian names is 'cow lee' and Professor Brewer thinks that enthusiastic philologists might suppose our name a corruption of that, but he adds, there is no evidence other than sound, of the connection of the two names." Watt (l. c., page 1107) gives "Chowlee" as one of the Indian names for the cow pea. Merrill has stated that the cow pea is a bean.

There has been much discussion as to where the cow-pea originated. In Bulletin No. 102, part VI, The History of the cow-pea and its Introduction into America, Wight makes the following statements: (page 5 (a) "Although the cow pea is the chief leguminous crop of the southern United States, the most diverse and often erroneous ideas prevail in regard to its geographic origin and the time and means of its introduction into American agriculture. It has been maintained by some, for example, that it is a native of tropical America: by others it was brought from Africa by the negro slaves and by still others that it was introduced by the United States Department of Agriculture." Again on page 6, "The conclusions which have been drawn are, briefly, that it was introduced into the

West Indies during the latter half of the seventeenth century and probably, reached the mainland during the first half of the eighteenth century; that it is a native of India and the region northwestward to the southern part of the trans-Caspian district; that its cultivation in that region is of ancient date; that its cultivation extended to China at a very early period; that it was known in Arabia and Asia Minor as early as the beginning of the Christian era, and was cultivated in at least one of the countries of southern Europe at about the same time, but that its introduction into central Europe was of much later date and entirely independent of its introduction into southern Europe." On page 17, same, "Practically all the varieties commonly cultivated in America belong to *Vigna unguiculata*, (L.), Walp. [*V. sinensis*, (Stickman), (Endll)], the species with larger seeds and larger pods which usually become pendulous when half their mature size or sometimes even earlier, and which are only slightly constricted between the seeds (Pl. II, and Pl. III, A.)"

The material used in doing this work has been identified by Merrill as *Vigna unguiculata*, (L.), Walp.

The cow-pea grown was obtained from a dealer in Manila (Luzon Floral Company) who got the seeds from Australia. It is known as the Black variety.

The Black variety may be classified as follows:

(1) Form of pea—kidney,
(2) Habit of growth—semi-recumbent,
(3) Time of maturity—very late,
(4) Color of pods—Light yellow hull,
(5) Color of pea—black,
(6) Size of pods—medium.
(7) Size of pea—medium.

The cow-peas were planted on ground that had been covered with a light undergrowth. As compared with reports of growth in the United States they grew fairly well. The peas were planted on the 16th of September. They flowered December 20 to 28th and the first mature fruit was taken on January 14th, 1913. The peas were planted 60 cm. apart in the rows and the rows were 90 cm. apart.

The weights of the seeds were as follows:

Largest old seed.....	0.221 g.
Smallest old seed.....	0.102 g.
Average old seed.....	0.204 g.
Largest new seed.....	0.224 g.
Smallest new seed.....	0.110 g.
Average new seed.....	0.200 g.

The seeds were quite uniform in size as a rule: The calculation for a hektare is as follows:

18426 hills
55278 plants
497502 pods
7462530 seeds
1492506 grams
1492.506 kilos.

The calculation for a hektare if the cow peas are sold at ₱.10 a kilo is ₱149.25.

Filipinos call the cow pea a "*sitao*" and eat it just as readily as the *sitao*. Many of them prefer the cow pea to the ordinary garden beans such as the Canadian Wonder. The native *sitao* has longer pods than the cow pea and the *sitao* can be raised along fences and around houses while the cow pea needs a cultivated place for its growth. Pigs eat the cow pea readily but prefer the *mungo* where both are growing side by side. (Experiment of Mr. Durham witnessed by the writer.)

The following table shows the relative compositions of Lima beans, navy beans, soy beans and cow peas. Farmers

Bulletin, No. 121, Beans, Peas and other Legumes as Food, Mary Hinman Abel, page 19.

The pods of the cow pea do not rot from contact with the ground, for they grow at the apex of the plant. The F_2 cow peas that were raised in the garden of the writer were badly attacked by aphids. The stored cow peas kept well and were little attacked by insects.

Material	*Water* %	*Protein* %	*Fat* %	*Chdts.* %	*Ash* %	*Fuel value per pound*
Lima beans.....	10.4	18.1	1.5	65.9	4.1	1,625 }
Navy beans.....	12.6	22.5	1.8	59.6	3.5	1,605 } Calories.
Cow peas.....	13.0	21.4	1.4	60.8	3.4	1,590 }
Soy beans.....	10.8	34.0	16.8	33.7	4.7	1,970 }

GLYCINE HISPIDA, (MOENCH.), MAXIM.

THE SOY BEAN.

The soy bean, called also the soya bean and the soja bean, is a native of Asia where it has been cultivated for thousands of years. While it has been cultivated extensively in China and Japan since ancient times its spread to surrounding countries has been slow. While it is now an important crop in India its introduction into that country has been recent. The soy bean has been recently introduced into the United States and it is cultivated extensively. Seed dealers carry in stock seven or eight varieties of the two hundred or more that have been introduced into America. The expansion of soy bean cultivation in Manchuria was due to the Russo-Japanese war. The Russian troops stationed in North Manchuria were provisioned to a considerable extent with soy beans. To meet the demands of the Russian government great quantities of the beans were raised. After the troops were withdrawn it was necessary to find a market outside and the surplus beans were sent to Japan. Owing to depression in Japan the trade dropped off and beans were sent to Europe. The growth of the exportation is shown by the following extract from the Bulletin of the Imperial Institute, Vol. VII, 1909, page 309, "The first cargo of soy beans consigned to the United Kingdom arrived in Hull on the 2nd of March, 1909, and amounted to 5,200 tons. It is stated that before June contracts had been made for the delivery of no less than 200,000 tons. These beans are said to arrive at the destination in perfect condition in spite of the great distance they have to be carried. They are classified into three grades: No. 1, shipped at Dalny; No. 2, shipped at Vladivostok; and No. 3, shipped at Hankow. The greater part, if not the whole, of the soy beans imported into this country is purchased by the proprietors of oil-mills, who crush the product and thus obtain a quantity of oil, amounting to about 10 per cent by weight of the seed, and a residual oil-cake which has proved to be a valuable cattle-food."

The genus *Glycine*, to which the soy bean belongs, has one indigenous representative in the Philippines, *Glycine tomentosa*, Benth. This plant is recorded from Ilocos Norte in the Philippines and from southern China and Australia. *Tomentosa* does not appear to be cultivated and the writer has been told by Mr. Merrill that, in his opinion, it has no commercial value. The following description is taken from a Bulletin of the Ohio Agricultural

Exp. Station, No. 237, February, 1912, page 241:

"The soy bean (Glycine hispida) is a summer annual which belongs to the family Leguminosae. It is an erect, hairy, bushy plant and from one-half to four feet tall. It usually has one main stem, on which there are from three to nine—usually five or six—branches. The leaves are trifoliate. The blossoms are borne in clusters and are purplish or whitish in color. The pods are from one to two and one-half inches in length, hairy, yellowish or brownish in color, and bear from one to four—usually two or three—seeds. The seed is smooth, roundish, somewhat compressed, and in color may be yellow, green, brown or black with varying shades between."

The soy beans used in this work were obtained from the Department of Agronomy of the College of Agriculture. They were known as "Ami's beans" on account of the fact that a student by the name of Ami had grown them on the College farm during the year 1912. The seeds resemble most the variety known as "Ito san." The beans were planted on September 16th, 1912. The ground where they grew was formerly occupied by a growth of underbrush. The beans made a slow growth at first on account of the cloudy weather. They were planted 60 cm. apart in the rows and the rows were 90 cm. apart. The beans blossomed about December 10th and the crop was gathered on the 16th of January exactly four months after they were planted. The soy beans ripened the most uniformly of any of the beans that were raised. The beans would bear as well if planted 40 dm. apart in the rows and the rows should not be more than 70 cm. apart. This is on the basis of three seeds to a hill. While this distance may seem close it is to be remembered that the soy bean "shrinks" when it begins to mature and many of the leaves fall off. The roots grew a number of nodules in the F_1 which increased when the seeds of the F_1 were planted on the same ground. The plants grew to a height of 70 cm. which is a good height for this variety.

The weights of the seeds are as follows:

Largest old seed.....	0.098 g.
Smallest old seed.....	0.092 g.
Average old seed.....	0.094 g.
Largest new seed.....	0.105 g.
Smallest new seed.....	0.092 g.
Average new seed.....	0.101 g.

The yield per hektare is calculated to be 3936 kilos.

The value of one hektare crop of soy beans is calculated at Manila prices to be ₱393.60*.

The principal use of the soy beans brought into Manila at present is for making bean-curd. The beans are brought from China for this purpose, principally from Amoy and Hongkong. The process of making bean-curd is described in the Philippine Journal of Science, Vol. VII, Section A, No. 1, page 49, as follows:

"The beans are soaked in water or in a salt solution, during which process pronounced swelling takes place, and they are then ground by hand between two millstones. The white, creamy liquid which flows from the grinder is ladled into a large caldron and there slowly boiled and coagulated into a white curd.

"The addition of gypsum water, or sea water containing magnesium chloride, is mentioned by various writers as necessary for the coagulation of the bean-curd.

"Inouye states that it seems most probable that insoluble calcium and

* Price to consumer.

magnesium salts of casein are precipitated from solutions of the sodium or potassium salts which are not precipitated by boiling, and the work of Osborne and Campbell bears out this statement.

"The curd is ladled out and small quantities formed into cakes about 8 by 8 by 3 centimeters, by folding into a small cloth. The cakes, each one still being wrapped in its cloth, are then pressed in a hand press to expel much of the solution. After removing the cloths they are baked slightly and then are ready for sale. The baking is not sufficient to harden the cakes to any great extent, and in appearance the interior is unchanged from the original white, while the exterior is light brown."

The soy beans are not relished by Americans and Europeans generally, and they have not found favor as a culinary plant.

Soy beans were planted at the same time and under the same conditions as the cow peas, common white beans, garden beans (Canadian Wonder) and Lima beans. The soy beans showed the greatest ability to gather moisture and germinate of any of the lot.

Soy beans may be planted with cow peas. The erect habits of the soy bean is of use in holding up the recumbently inclined cow pea. Soy beans and cow peas make an excellent hay. In planting soy beans and corn together care should be taken to not cover the soy beans too deeply as they will not grow if planted too deep. Soy beans may be sown with sugar cane. They may also be sown broadcast among coconuts. Soy beans may be grown for their seeds alone as these bring a good price in the markets of the world.

CONCLUSION.

In the opinion of the writer the cow pea is the best bean for general introduction into the Islands of any of those treated in this work. It should, of course, be kept in mind that some of the reasons for placing the cow pea at the head of the list will apply with equal, or even greater, force to some other individual beans.

The cow pea is a native of a warm country.

It is both a garden and a field bean.

It improves the soil by the addition of vegetable matter and nitrogen.

Soil inoculation is not necessary in the Philippines for the development of the tubercles.

It is useful as a forage crop and may be utilized as hay, as a soiling crop, for silage, or for pasturage.

It is easily handled as a field crop.

The seeds are adapted for storage and do not mould easily.

It has a wide adaptation as regards soil as seen by the many places that it is grown successfully.

It resembles the Filipino "sitao" which is a favorite bean for culinary use in the Islands.

Some Experiments on the Growth of Rice in Water-Culture

By Valente Estrada Villegas

Thesis presented for graduation from the College of Agriculture. No. 10

Introduction.

Cogon soils are well-known to be inferior in crop-producing power. It is a common belief that these soils are either impoverished by the growth of cogon or that the latter excretes some poison which affects the growth of succeeding crops. The effect of grasses in poisoning soils has been studied at Rothamsted, but the only work done towards isolating definite poisons is that by the different workers of the Bureau of Soils, U. S. Department of Agriculture[1].

The various toxic substances which have been isolated are monohydroxystearic acid, dihydroxystearic acid, picoline-carboxylic acid, and others. Aside from these, cumarin, and other compounds known to be poisonous to plants, probably occur in the soil. Of the above compounds, dihydroxystearic acid is perhaps the most widely distributed; on this account the search for toxic substances in cogon soil was begun with a preparation which corresponded in solubility and in method of extraction with the acid named.

Rice was selected for the experiments and grown in water culture. The conditions of the experiment were first patterned after the work of the observers in Washington in order to find out whether the conclusions reached by them in the case of wheat seedlings apply also to rice.

After a series of water cultures had been run the conditions were modified as experience showed necessary and the experiments were repeated, but instead of using cogon soil extract, preparations were applied from soil obtained from under a clump of bamboo. In addition to testing the effect of the soil extract on the growth of rice seedlings, some experiments were made with a view to ascertaining what sort of nitrogen compounds can be hydrolyzed by the roots of the rice plant, with subsequent utilization of the ammonia set free.

The work which follows is accordingly divided into three sections.

I. Rice in Water-Culture, with and without an Extract from Cogon Soil.

The compounds selected to provide plant food to the seedlings were superphosphate, potassium sulphate, and sodium nitrate. The stock solution of the calcium acid phosphate used had a concentration of 323 parts per million of P_2O_5. The sodium nitrate and potassium sulphate solutions had a concentration of 1000 parts per million of NH_3 and of K_2O respectively.

The soil extract used was prepared according to the method given by Schreiner and Skinner[2] from five kilos of soil growing cogon.

The soil was treated with a two *per-cent* solution of sodium hydroxide for forty-eight hours, with occasional shaking. On the third day, the dark brown alkaline supernatant liquid was decanted into a vessel and acidified with nitric acid. The liquid was then filtered through a fluted filter, and the filtrate extracted with ether. Most of the ether was distilled over a bath of hot water.

The extract with the remaining ether was poured into a small amount of water. The brownish flakes separating were soluble with difficulty in hot water. The solution obtained was used in the succeeding experiments. It would

include dihydroxystearic acid if present in the soil, together with certain resinous bodies.

The rice seedlings were grown in 400cc. Jena beakers, the inside of which had been carefully coated with paraffin. The outside was wrapped with brown paper to exclude light. To hold the plants in position over the solutions, round cork sheets were used, the seedlings being held in place by means of small wisps of cotton. Each beaker held five plants.

Uniform seedlings are an indispensable requirement. In order to procure them, unthrifty looking ones were discarded, those of the same size being allowed to remain.

Impurities adhering to the roots of plants would also lead to erroneous results. The medium in which these seedlings were germinated was the purest redistilled water and ignited white sand.

Each beaker was supplied with 72 c.c. of the stock fertilizer solutions (either in mixture or singly), and enough water added to make approximately 400 c.c.

Table I. Distribution of Stock Solutions.

	Stock solution			*Concentration. Parts per million*		
Beakers.	$CaH_4(PO_4)_2H_2O$	K_2SO_4	$NaNO_3$	P_2O_5	K_2O	NH_3
	c.c.	c.c.	c.c.			
1 & 11	72	0	0	58.14	0	0
2 & 12	48	12	12	38.76	30	30
3 & 13	36	36	0	29.07	90	0
4 & 14	36	0	36	29.07	0	90
5 & 15	24	24	24	19.38	60	60
6 & 16	12	48	12	9.69	120	30
7 & 17	12	12	48	9.69	30	120
8 & 18	0	72	0	0	180	0
9 & 19	0	36	36	0	90	90
10 & 20	0	0	72	0	0	180

In addition to the above solutions one tenth of the extract from 5 kilos of cogon soil was applied to each of the ten beakers numbered 11 to 20 inclusive; each of these received an amount of extract equivalent to that obtained from 500 grams of soil. Numbers 1 to 10 inclusive serve as checks and received no soil extract.

The distribution of the above solutions was made four times during growth. At each renewal of the solution, the old material was diluted to 500 c.c., 50 c.c. being taken and reserved in glass-stoppered bottles for analysis. The amount by the end of the experiment was thus 200 c.c. from each culture, containing one tenth of all the fertilizing elements left after the growth of the plant.

The experiment was begun June 16th and ended July 17th, 1912. Growth records were made at the middle of the experiment and at its end.

From table II it will be seen that the plants numbered 5, 6 and 7 of the set 1 to 10 have grown much faster than the others during the first period; that is to say, the beneficial effect

Table II. Growth of the plants in millimeters (measured by longest leaf), and air-dried weight in grams.

Plant No.	*1st two weeks*	*2nd two weeks*	*Total*	*Air-dried weight*
1	17	1	18	.10
2	29	4	33	.135
3	18	2	20	.126
4	20	1	21	.154
5	130	18	148	.535
6	103	72	175	.627
7	75	24	99	.546
8	74	21	95	.279
9	58	1	59	.234
10	42	1	43	.17
11	19	1	20	.11
12	27	1	28	.12
13	32	1	33	.128
14	30	7	37	.145
15	18	2	20	.107
16	48	116	164	.405
17	92	79	171	.506
18	33	8	41	.238
19	116	16	132	.498
20	77	40	117	.395

of certain mixed fertilizers is marked. Of the plants with single fertilizers, number 8, where potassium was the only constituent, grew faster than the rest. The second period brought a change in the relative development of the plants, the growth being very much less than before.

The set of plants from number 11 to 20 behave differently. A peculiar growth was noticed with plant 16, which grew much faster than the others during the second period. The extract was found to have harmfully affected the growth of plants 12, 15, 16, and 18, while in the case of plants 17, 19 and 20, where nitrogen is the principal fertiiizing element, a stimulation of growth was recorded.

At the expiration of the experiment the plants were air-dried, and their weights recorded in the last column of the table above. Numbers 17, 19 and 20 where nitrogen is the principal fertilizing element have been stimulated by the application of the soil extract. In all other cases the growth of plants with the soil extract has been unfavorably affected, if we except numbers 11 and 13 (principal fertilizer $P_2 O_5$), where the growth with and without the soil extract was about equal. The best growth observed in the cultures without soil extract was with numbers 5, 6, and 7, where the fertilizing elements were mixed in nearly equal proportions. On the other hand the best growth observed where soil extract was used was in the case of the plants which received large amounts of nitrogen. This outcome of the experiment is similar to that obtained by Schreiner and Skinner with wheat seedlings.[1]

The preserved solutions, amounting to 200 c.c. from each culture, were diluted to 500 c.c. before analysis.

For the nitrate determination 10 c.c. of each of the diluted solutions was pipetted and evaporated to dryness in an evaporating dish over a water bath. To the dried cooled residue, 1 c.c. of phenoldisulphonic acid was added with stirring, allowing the reagent to act for ten minutes. The whole material was then diluted with water and made alkaline with ammonium hydroxide. The yellow solution formed was made up with water to 100 c.c. in a Nessler cylinder. The intensity of color determines the amount of ammonia contained in the solution when another tube of a known concentration is used as a standard of comparison.

50 c.c. of the diluted solution were taken for the colorimetric determination of potassium, iodine being liberated from potassium iodide by means of potassium chloroplatinate.

Phosphorus was precipitated as ammonium phosphomolybdate and titrated against KOH solution of known strength. This is the well-known method of Pemberton.

Table III gives the result of the analysis of the solutions after rice plants had been grown in them.

In many cases the amount of plant food removed from the solution by the seedlings is equal in the cultures with and without the soil extract. Where there is a difference, the plants grown in the presence of soil extract absorbed the most mineral food. Of the forty analyses made only four occur where the reverse is the case. The exceptions, underlined in the table, tend to occur in those cultures where nitrogen predominates.

II. The Growth of Rice in the presence of various nitrogen compounds.

After detecting a peculiar action on the part of sodium nitrate, it was thought well to secure information concerning the growth of rice in the presence of other nitrogen compounds. This was done with a view to ascertaining whether

1 Loc. cit.

Table III. Analysis of Culture Solutions.

(Parts per million).

Solution Numbers	Original Concentration			Final Concentration			Amount Absorbed		
	NH_3	P_2O_5	K_2O	NH_3	P_2O_5	K_2O	NH_3	P_2O_5	K_2O
1	0	58.14	0	0	3.33	0	—	54.81	—
2	30	38.76	30	15	1.406	18.7	15	37.33	11.3
3	0	29.07	90	0	1.28	——	——	27.79	——
4	90	29.07	0	37.5	3	0	52.5	26.07	——
5	60	19.38	60	25	0.62	37.5	35	18.76	22.5
6	30	9.69	120	9.3	5.25	46.2	20.7	4.44	73.8
7	120	9.69	30	62.5	1.53	21.2	57.5	8.16	8.8
8	0	0	160	0	0	62.2	——	——	113.6
9	90	0	90	37.5	0	37.5	52.5	——	52.5
10	180	0	0	31.2	0	0	148.8	——	——
11	0	58.14	0	0	1.65	0	——	56.61	——
12	30	38.76	30	12.5	.5	16.2	17.5	38.71	13.8
		07	90	0	.68	22.5	——	28.39	6.75
13	0	29.							
14	90	29.07	0	37.5	.71	0	52.5	28.36	——
15	60	19.38	60	31.2	.62	27.5	28.8	18.76	32.5
16	30	9.69	120	9.3	1.13	——	20.7	8.51	——
17	120	9.69	30	43.7	.31	11.2	76.3	9.38	18.8
18	0	0	180	0	0	78.7	——	——	101.3
19	90	0	90	43.7	0	35	46.3	——	55
20	180	0	0	37.5	0	0	142.5	——	——

the phenomena noted were due to the specific properties of nitrogen as an element or whether they might have been caused by some property characteristic of sodium nitrate as a salt.

Results obtained were not conclusive and will not be given here, but other information obtained is of interest, in that it shows what sort of nitrogen compounds can be utilized by the rice plant.

The seeds were carefully sterilized in bromine water in a vacuum, and transplanted into sterile solutions according to a technique recently perfected. The cultures using potassium nitrate, ammonium sulphate, asparagin, glycocoll, and formamide as sources of nitrogen all flourished. The plants in the presence of hippuric acid, hydroxylamine, p-toluidin and urea soon died. These facts indicate, since the plants were grown under sterile conditions, that the roots of rice plants are able to decompose both amino-acids and acid-amides and make use of their nitrogen. Urea is apparently not an available source of nitrogen; and the toxic effect of the hydroxylamine hydrochloride, hippuric acid and p-toluidin was to be expected.

III. The Growth of Rice in the Presence of a Soil Extract Obtained from Under a Clump of Bamboo.

The application of the nutrient solutions differs here from that of the preceding cultures. The solutions were allowed to remain in the culture vessels with repeated additions of plant nutrients, thus increasing the concentration to an amount approximately three times as large as that used in the preceding experiments. The record of growth and final weight is given below.

The above table shows that every plant receiving soil extract was very unfavorably affected in its rate of growth and in final weight. The difference in weight is especially marked in the case of the plant having a mixed fertilizer. The

Table IV. Growth and Weight Record.

Plant Nos.	*Total growth of longest leaf.*	*Total air-dry weight.*
	cm.	gm.
1	20.5	.2730
2	28.5	.8750
3	23.3	.380
4	24	.418
5	27	.672
6	38	1.426
8	25.6	.466
9	24	.412
10	19	.148
11	16	.101
12	21	.414
13	20.5	.259
14	20	.162
15	22	.214
16	24	.272
18	23	.221
19	23.6	.255
20	17	.131

application of nitrogen alone in the case of plants receiving soil extract fails this time to stimulate the growth though the difference observed is not so great as it is in the case of plants receiving a mixture of fertilizing elements.

SUMMARY

Rice grown in water culture containing substances extracted from cogon soil is generally retarded in its growth; where sodium nitrate is the predominating fertilizer stimulation of growth is observed. The extract from a soil growing bamboo retards the growth of rice in every case, though the effect observed is less in the case of the plant grown in a solution containing sodium nitrate as the sole nutrient salt.

These observations seem to confirm those obtained by Schreiner and Skinner (1) in their work with dihydroxystearic acid and wheat seedlings, where the uniformly harmful effect of this soil constituent was found to be least in the presence of fertilizers mainly nitrogenous. The effect of the poison, in stunting the root development and in causing the plant to have a spindling growth, was noticed in both investigations.

However, in spite of the seeming agreement, the fact remains that none of the plants experimented with grew well in the water cultures used. Either rice requires a higher concentration of nutrient salts than does wheat, or else the slight acidity of the cultures due to the use of superphosphate is more detrimental to the growth of the former plant. It is evident that the removal of nitric acid from the solutions containing sodium nitrate will tend to develop an amount of alkali sufficient to more or less completely neutralize the acidity due to superphosphate. In fact the solutions containing predominating proportions of sodium nitrate were the only ones which were neutral at the end of the experiment.

The Washington observers conclude that the protective effect of sodium nitrate in the presence of dihydroxystearic acid is due to some mysterious influence of nitrogen as an element. It seems more reasonable to suppose that in solutions containing sodium nitrate the dihydroxystearic acid tends to become neutralized by an alkali and rendered less toxic.

We, therefore, conclude merely that cogon soil and soil growing bamboo contains a substance or substances injurious to the growth of rice in acid media; whether the toxic action would be noticed if the plants were grown in neutral or slightly alkaline media remains for further investigation. The work is expected to be continued by other students of this College.

The writer wishes to express his obligations to Associate Professor H. G. Deming, under whose direction the work was undertaken.

(1) Bureau of Soils, U. S. Department of Agriculture, Bulletin 70.

The Forest School Nursery and Plantations

By M. J. Oteyza, *M. S. F.*, *Instructor in Sylviculture.*

THE NURSERY

The Forest School Nursery established in July of 1911 was intended to give the students in Sylviculture and Forest Management practice in nursery work, to find the best way of handling different seeds and to acquaint the students with the seedling form and habits of the various timber trees. With these objects in mind, the forms and sizes of seed beds used, the kinds of mulch, various ways of transplanting, seed treating to hasten germination, experiments with cuttings, system of record keeping and of labelling, all were tested with a view of settling upon whichever proved to be the most practical method.

THE NURSERY.—The old Nursery has an area of 360 sq. m. and the new Nursery made by the Forest School students has 1093 sq. m. In both areas the soil is unsuited for nursery purposes unless improved by addition of sand and vegetable material. Although close to a creek the intervening bank is so steep that hand watering (which was all the water system at our disposal) was resorted to only a few times during the dry part of the year. Throughout the perio t covered in the report no effort was made to shade the nursery beds or to water them continually or to improve the poor mechanical condition of the soil; so that these may be reasons for the low rate of germination obtained. However, the figures would show what degree of success can be reasonably expected of the different species we handled when grown under as adverse conditions as these.

SEED BEDS.—The Nursery was divided into three portions separated from one another by paths one meter wide. One portion was made into raised beds, one meter and two meters wide by ten meters long which were to be used for small quantities of seed. Another portion was not divided into beds, the seed being merely planted in rows 20 cm. apart and the different species distinguished with labels on both ends of the rows. A third portion was used for nursery rows.

Raised beds are of no use here. They wash out badly during the rains; the water flowing in the paths carries the seeds away, putting the matter of keeping germination records out of the question. Besides, in dry weather, raised beds are difficult both to water and to keep moist. Flat beds did not have these troubles although in heavy rains some seeds were uncovered.

NURSERY LABELS.—Madrecacao labels made from sticks 2½ to 3½ cm. in diameter, and bamboo labels have been tried. Madrecacao can be gotten easily in this vicinity and is easy to trim; but if used unpainted, labels become fungus-stained within one week, which makes any writing on them illegible. Madrecacao labels of the above diameter and 35 cm. long cost ₱3.25 a thousand to gather and trim. Bamboo labels when made of sufficient thickness (8 mm.) give better service and its use is advisable wherever it is abundant. Labels made of seasoned bamboo will last two or three years while Madrecacao which suffers both from anay and bokbok attacks is serviceable for only one year unless treated with some preservative. Bamboo labels 5 cm. by 30 cm. long cost ₱2.50 a thousand to gather and trim.

MULCH.—The soil of the nursery is of a clayey nature so that mulching becomes a necessity, to lessen the rapid evaporation from the surface. For this purpose, cogon grass, which is

a clean mulch, abundant and easy to gather has been used.

Chopped cogon grass, while it does not interfere with the growth of the young seedlings and is not blown around by the wind, is more costly and not as easily renewed as when the cogon blades are used whole. Entire blades of cogon grass, with some care, can be uniformly and thinly laid on the beds, can be kept in place with weights of small sticks and at transplanting can be easily taken up, leaving a clean surface of ground to work on. The shoots of the young seedlings are able to find their way out to the light but require some attention until they are out of danger of being crushed or broken by the weight of the mulch. This sort of mulching costs ₱0.11 per sq. meter of ground covered, which includes gathering the grass, transportation for a distance of one fourth of a kilometer, and spreading it on the ground.

TRENCHED BEDS.—Four seed beds, each 1.5 by 3.0 meters were prepared by replacing the soil with a more friable and fertile mixture, to a depth of 50 cm. Two of these beds were given two parts of soil obtained from among bamboo clumps which appeared to have good texture because our wood broken up by fine bamboo roots; one part wood, bamboo and cogon ash, and one part stable manure. For the other two beds, fine sand was obtained from the creek bank and applied in the above proportion, the surface layer, however, being composed of ¾ of this fine sand and ¼ ash and manure mixed. The first two beds become tightly packed under daily watering while the latter two kept their porous texture. In both cases the cost was nearly the same,—₱3.40 per sq. meter.

SEED BOXES.—The boxes are 40 by 50 by 10 cm. in size, with wooden sides and bamboo bottoms, made at the cost of ₱0.48 per box including the cost of the material.

Black ants gave considerable trouble with fine seeds, which were carried away. Standing the boxes on empty rice sacks soaked with creosote oil enabled us to avert this trouble. During dry weather the ant pest was not as active and we avoided it by placing the boxes on suspended frames which were large enough to hold eight to ten boxes of the size mentioned.

SHADING—In the operations in the nursery, the expense of shading was avoided but with some transplants it was necessary to use some sort of shade for the first week after moving the plant. Cogon mats were too expensive to make and it was found difficult to keep them in place during windy days. Layers of the body of the banana last four to five days in the hottest weather, which is all the period of shading required by delicate transplants.

For shading the four trenched beds mentioned above, a tent fly made of sinamay cloth strips sewn together was made. This shade gives sufficient protection against heavy rains at the same time allowing enough light to pass through it to prevent an undue growth in height of seedlings. The frame cost ₱1.80 to build and the sinamay cloth (very coarse) cost ₱0.40 per sq. m.

List of species sown in the Forest School Nursery from July, 1911, to March 31, 1912, giving the rate per cent of seed germination.

Lot No.	*Name of Species*	*Per cent germinated*
474	Pritchardia Gaudichaudii	50
476	Cocos romanzoviana	5
480	Elaeis guineensis	26
481	Latania glaucophylla	50
501	Schinus molle	16
517	Cassis fistula (P. I.)	15
518	Cassia nodosa (P. I.)	16
522	Albissia Acle (boiled)	23
525	Ziziphus zonulatus	1
530	Areca rubra	7
531	Cocos romanzoviana	0.6

Lot No.	Name of Species	Percent germinated
539	Oreodoxa regia (only few seeds)	6
543	Erythrina indica	11
551	Aleurites moluccana (old seed; ground)	11
554	Brachychiton acerifolium	25
552	Cassia grandis	35
564	Elaeis guineensis (trenched beds)	90
576	Cassia nodoza	17
580	Ceasalpinia Sigillessi	40
594	Acacia Koa	18
600	Dracontomelum cumingianum	34
601	Bombycidendron vidalianum.	17
602	Erythrina indica	65
296	Pithecolobium montanum	52
292	Intsia bijuga	24
294	Pterocarpus indica	8
605	Dracontomelum cumingianum (Bataan)	47
606	Leucaena glauca	38
616	Diospyros pilosanthera	14
428	Sandoricum indicum	27
431	Terminalia edule	11
470	Prosopis vidaliana	7
471	Aleurites moluccana (Maquiling; ground seeds)	39
710	Caejia laevigata	16
737	Anisoptera thurifera	11
483	Erythrina monosperma	68
484	Cassia grandis	40
484	Cassia nodosa (Hawaii)	36
486	Cassia fistula (Hawaii; treated)	57
492	Cupressus macrocarpa	3
496	Caesalpinia Gillessi	45
497	Manihot Glaziovii (treated by burning)	8
498	Acacia Koa	38
505	Washingtonia filifera	41
507	Prosopis juliflora (untreated).	57
508	Albizzia Lebbec	11
512	Jacaranda mimosaefolia	7
523	Tectona grandis	26
527	Albizzia Acle (Tayabas, untreated)	50
533	Tectona grandis (old seeds)	3
542	Cystophyllum fragans	30
546	Albizzia Acle (9 seeds only, untreated)	100
548	Eugenia grandis	74
556	Manihot Glaziovii (untreated)	23
563	Erythrina monosperma	71
582	Cassia fistula (Hawaii; untreated)	48
590	Cryptostegia grandiflora	34
591	Prosopis juliflora (untreated).	20
596	Casuarina quadrivalvis	3
597	Jacaranda mimosaefolia	1
607	Albizzia Acle (untreated)	5
608	Cassia fistula (Bataan; untreated)	4
404	Casuarina lepidophloia	29
405	Casuarina inophloia	22
407	Casuarina suberosa	28
409	Callistemon salignus	30
595	Washingtonia filifera	20
411	Callitris Mulleri	11
412	Callitris robusta	2
475	Oreodoxa regia (big planting).	8
426	Albizzia Acle (ground seed)	68
248	Eucalyptus robusta	0.8
241	" cornuta	2
244	" pilularis	3
	Robinia pseudacacia	22
618	Vitex parviflora	12
619	Cinnamomum Camphora	1.6
620	Taclang anac	71
621	Artocarpus cumingiana	49
622	Sindora Supa	12
623	Sindora Supa	12
624	Xylia dolabriformis	3
625	Cassia fistula	20
626	Sindora Supa	12
627	Coffea liberica	50
630	Cordia Blancoi	37
631	Pinus insularis	90
632	Tectona grandis	17
633	Strombosia philippinensis	36
634	Malaruhat (Eugenia sp.)	13
635	Artocarpus incisa	0.5
636	Lumbia	32
637	Tectona grandis	23
638	Pandanus sp	0.2
639	Ziziphus trinervia	19
640	Livistona sp	22
641	Niogniogan	88
642	Cyathocalyx globosus	57
643	Dipterocarpus sp	13
644	Garcinia sp	80
645	Quercus sp	5
646	Terminalia Catappa	3
647	Dehaasia sp	44
648	Bischofia javanica	18
650	Pahudia rhomboidea	39

SUMMARY OF THE WORK IN THE NURSERY AND ON 1½ HECTS OF PLANTATIONS.

Total number of Species planted from July, 1911, to March, 1912 192
Number of Species that failed to germinate 65
Average cost per month of maintaining the Nursery and the Plantations .....

	Student labor.	*Paid labor.*
Sowing in the Nursery, sowing at stake, seed grinding, seed collection, weighing	₱60.50	₱ 7.80
Nursery reports, plantations maps, making of labels, keeping records	23.30	
Transplanting to Nursery rows, transplanting to Plantation Areas	29.20	1.20
Care of Nursery, watering, care of plantations	7.80	17.70
Marking new areas for planting (stakes set one meter apart)	22.20	
Clearing new areas for planting	3.90	10.60
Total	₱146.90	₱37.30

THE PLANTATION

For purpose of demonstration, experiment and to enable the Students of the Forest School to study the growth rate of trees, these plantations were started in July of 1911. There are at present six distinct areas in plantation, aggregating one and a half hectares, of which only 1-15 is out of view from the student's quarters.

The greater portions of the plantations are on hillsides of 10—50% declivity and all occupy ground that has been, previously to clearing, occupied by a rank growth of talahib and cogon grass.

The plants are one meter apart from each other except in the case of Rubber plants (*Manihot dichotoma* and *Hevea braziliensis*) which are spaced 4 by 4 meters. This spacing was held to be convenient in caring for the plantations with the limited amount of labor we had.

It is important to state that we had undertaken transplanting in all kinds of weather and seasons, that each species was transplanted in various manners to test the degree of care each would require and that in a few cases only we resorted to shading the plants after moving.

A glance at the list of plants in our plantations would show a large per cent of failure with some species, a condition which could have been greatly improved if we had done our transplanting at the start of the rainy period; but as over half of our work in this line had to be done toward its close, the plants had only time to recover from the moving and were unable to face the prolonged drought.

It would have been better to leave the seedlings in the seed beds; or, in the case of crowded sowings, the seedlings could have been moved to and cared for in the nursery rows. However, out of this loss of plants, we have gained a knowledge as to what species could be transplanted right out of the seed beds into their permanent places in the field without great failure, what species needed hardening in the nursery rows, and what ones could be transplanted with bare roots even in trying weather conditions.

List of the species handled in the Plantations of the Forest School giving the number of plants planted and the *per cent* of success June 1st, 1912:—

AREA I.

Lot No.	*Species*	*Date planted.*	*No. planted.*	*No. alive*	*% alive.*	*Average height 6-1-12*	*REMARKS*
650	Tindalo.....	4-22-11	43	11	25%	32 cm.	Growing slowly.
798	Ceara rubber....	12-14-10	24	24	100%	48 cm.	Doing very well.
622	Supa.....	12-06-11	74	21	28%	19 cm.	Very promising.
632	Teak.....	6-24-10	80	75	94%	40 cm.	
797	Ipil.....	Limay.	16	6	32%	33 cm.	
582	Cassia fistula....	8-24-11	221	116	52%	26 cm.	Stands drought well (From Hawaii.)
517	" "	P.r	45	35	78%	10 cm.	
	Oak.....	——	11	0	0%	——	

AREA II.

Lot No.	*Species*	*Date planted.*	*No. planted.*	*No. alive.*	*% alive.*	*Average height 6-1-12*	*REMARKS*
799	Ipil-ipil.....	7-11-11	180-000	112-000	62%	——	Seed broadcast after cutting down the grass.

AREA III.

Lot No.	*Species*	*Date planted.*	*No. planted.*	*No. alive.*	*% alive.*	*Average height 6-1-12.*	*REMARKS*
648	Toog	9-29-09	21	17	81%	90 cm.	
647	Dehaasia	10-11-09	36	15	42%	85 cm.	
634	Malaruhat	6-02-10	71	26	37%	45 cm.	
619	Camphor	2-28-10	18	11	61%	80 cm.	Trans. with care but in a very hot day.
633	Tamayuan	9-27-09	17	1	6%	45 cm.	
642	Latuan	3-10-11	20	0	0%	0 cm.	
486	Cassia fistula (Hawaii)	7-11-11	163	119	72%	25 cm.	
618	Molave	12-21-10	19	13	68%	30 cm.	
635	Antipolo	10-21-09	3	3	100%	45 cm.	
800	Lamog	Limay	4	0	0%	——	
801	Malaruhat	"	4	2	50%	40 cm.	
426	Acle	9-30-11	269	231	86%	35 cm.	Trans. direct from seed-beds, 1 week after germination.
	Sacat	Limay.	2	0	0%	0	
803	Santol	"	4	1	25%	85 cm.	
804	Taluto	"	3	1	33%	70 cm.	
805	Para rubber	12-23-12	109	90	83%	70 cm.	Bare roots—plants 1½ meters tall.
806	Ipil-ipil	9-26-11	221	200	91%	100 cm.	
	" "	9-30-11	45	29	64%	170 cm.	Stake sowing.
807	Lamio	Limay.	5	5	100%	10 cm.	Cutting transplanted.
808	Pinkado	"	3	0	0%	——	
809	Mahagua	4- 5-11	9	8	89%	70 cm.	
644	Bilucao	8-16-09	144	0	0%	——	
646	Talisay	8-17-09	6	5	83%	110 cm.	
	Podocarpus Blumeii	Limay	20	0	0%	——	
548	Eugenia grandis	8- 9-11	50	42	84%	50 cm.	From Singapore.
484	Cassia grandis	7-13-11	67	9	13%	20 cm.	From Hawaii. (Compare Cassia fistula from Hawaii and Cassia fistula from P. I.)
498	Acacia Koa	9-28-11	71	5	7%	35 cm.	
545	Lumbang	8- 5-11	55	51	93%	95 cm.	
483	Dapdap	7- 9-11	24	22	92%	50 cm.	
485	Cassia nodosa	7- 3-11	148	67	45%	100 cm.	
248	Eucalyptus robusta	10 11-12	45	31	69%	40 cm.	
183	Lanutan	8-29-11	330	115	35%	25 cm.	
637	Teak	9- 1-11	234	134	57%	40 cm.	½ of number under 5 cm. tall at transplanting.
639	Balacat	5-09-10	30	2	7%	35 cm.	
507	Prosopis juliflora	7-21-11	19	0	0%	——	

REFORESTATION.

In connection with the course in Forest Management, experiments on a reduced scale are being carried on, to turn into productive tracts the mountain land now entirely taken up by wild grass, inside and skirting the Forest Reserve boundaries. It is understood that the advance of the forest border line towards reclaiming the cut-over and burnt-over areas becomes exceedingly slow, the annual fires killing all vegetation except the grass up to the forest border and often even penetrating the forested area, killing trees of 5 to 10 years standing. Our ultimate object would be to extend the forest down to the settlements, barrios and towns, leaving only what lands are suited and actually used for farming.

To prepare the way for this purpose endeavors are made to extirpate the

AREA IV.

Lot No.	Species	Date planted.	No. planted.	No. alive.	% alive.	Average height 6-1-12	REMARKS
637	Teak	6-24-10	22	8	36%	65 cm.	Plants were too large. Compare success of other Teak trans when under 15 centimeters.
621	Anubing	6-21-10	92	8	9%	——	Bare root.
812	Narra seedlings	——	48	23	88%	156 cm.	Bare root—planted early in wet season.
	Narra cuttings	——	170	17	10%	56 cm.	Planted after callusing but in dry season.
818	Ipil	Seedlings.	64	0	0%	——	Bare roots (seedling) over 1 m. tall.
814	Lanutan	"	117	0	0%	——	Bare root (merely pulled up).
820	Rattan	"	137	0	0%	——	
	Lamio	"	13	1	7%	30 cm.	" " "
819	Para rubber	12-23-10	94	27	30%	56 cm.	" " "
	White lauan	Limay	70	0	0%	——	Seedlings from Bataan suffered in transit.
816	Tanguile	"	96	0	0%	——	" " "
	Guijo	"	78	0	0%	——	" " "
	Panao	"	130	0	0%	——	" " "
815	Mayapis	"	72	0	0%	——	" " "
817	Apitong	"	56	0	0%	——	" " "

AREA V.

Lot No.	Species	Date planted.	No. planted.	No. alive.	% alive.	Average height 6-1-12	REMARKS
821	Para rubber	12-23-10	160	88	55%	65 cm.	Bare roots. Plants 1½ meter.
426	Acle	10-17-11	2312	73	37%	19 cm.	Stake sowing done in the dry season.
471	Lumbang	10-15-11	337	110	110%	27 cm.	"

AREA VI.

Lot No.	Species	Date planted.	No. planted.	No. alive.	% alive.	Average height 6-1-12	REMARKS
882	Para rubber	12-23-10	35	25	71%	60 cm.	Bare roots, plants 1½ meter.

cogon grass by plantations of parang species. Parang species are naturally more resistant to droughts and fires than the forest species and a few of them are useful for fence and house post, besides being generally used for firewood.

Of these species, *ipil-ipil*, *cacahuate* and later *aroma* were settled upon for use in this work. It has been observed that groves of these parang species, because of their density of growth, resistant qualities and prolificacy were able to shade out all grass growth inside their boundaries, and to extend their area usually by their profuse seeding.

Towards November of 1911 some broadcasting and spot-sowing of Ipil-ipil seeds were made on areas recently burnt-over, (2 hect.) the result of which will be observed during this year.

Plantation Area II is an experiment to replace cogon grass by *ipil-ipil*. It was started July 11, 1911, and on April 1st, 1912, there were 73% of the seedlings alive, the tops of 10% of which were 20 cm. above the tallest cogon on the area. The seedlings that have grown above the cogon have a height of 107 centimeters.

BAMBOO STUDIES

The Agricultural College Grounds contain 424 clumps of bamboo which have been turned over to the Forest School for their management.

The preliminary work of mapping and counting the stock has been done, the College Grounds divided into Blocks to each of which 2 students of the Senior class were assigned.

The clumps were numbered and carefully located on a map where each clump also bears its number. Complete description of each clump is in the office to aid in the work of management. Thus, at one glance, one can tell the over-cut clumps and those that are in need of thinning or harvesting.

We have distinguished for our purposes only three kinds of bamboo. The thorny kind which is mostly used on account of its durability, the thornless which is soft and less durable, and the bojo kind which is used seldom save for walls, when it is crushed and made to lay flat for weaving.

For cutting purposes we have adopted the following terms:

1. Young bamboo.
2. Poles (mature but with small diameter).
3. Posts (butts 3—5 meters long, left by previous bamboo cutters).
4. Wind-broken (canes useful only for temporary structures and where great strength is not called for).
5. Mature.
6. Marked (canes recommended for cutting).

The immediate problem in managing these clumps is that of restricting the cuttings from "handy" clumps which are greatly over-cut. Next comes the utilization of poles whenever they are needed instead of cutting down mature canes merely to obtain their tops, of broken canes for temporary structures and of sound posts that deteriorate rapidly without being used. Then comes the training of bamboo cutters to harvest the canes by severing them within 18 inches to 2 feet from the ground. This last practice, up to this time, has required loss of time in getting to the bamboo butts but it is expected that subsequent harvests will make this practice less and less difficult of accomplishment.

No cost figures for bamboo harvesting have been collected from the clumps under management as the demand here is very irregular and in small amounts but we have secured date from a harvest of bamboo on private land just outside of the College Area.

HARVESTING BAMBOO

Cost per 100 *Canes.*

Stumpage at ₱.10	₱10.00
Cutting	10.87
Hauling (distance 400 meters) with sled	1.17
Total	₱22.04

Cost of Bamboo from Dealers.

Bamboo cut and seasoned per 100 canes	₱22.92 to ₱25.00
Hauling (distance 2 kilometers) with cart	2.08
Total delivered	₱25.00 to ₱27.08

From studies that will be made this year we aim to obtain figures for the growth rate of bamboo, the best density for their growth, the cost of establishing bamboo plantations, and other data required to show the business opportunities with this crop.

The Tropical Agricultural College

C. F. Baker, *Professor of Agronomy, College of Agriculture, University of the Philippines.*

The development of Tropical Agriculture has been brought about not so much by the slow evolution of a native peasantry, as by direct government influence and assistance, encouraging the investment of large foreign capital in extensive estates and assisting the development of these by colonial departments of agriculture and experimental stations. This is in sharp contrast to the course of events in most temperate regions. Much of this rapid estate development has occurred in countries already more or less thickly inhabited by agricultural peoples, and it has been of infinite service in the opening up of these countries and building foundations for the civilizations possible therein. Government attention has been largely centered in the interests of this estate development; but even in some of the countries where it has been most rapid, the amelioration of conditions surrounding the native peoples has proceeded but slowly. It is true that law and order have come with foreign occupation, and that the sanitation of these countries has proceeded apace, though it must be said also that many evils have inevitably followed the coming of the "higher" civilization. Educational development has been slow. The modification of native methods in agriculture has proven a difficult undertaking. The increase of estates in some regions has rather tended to decrease even temporary land tenure among the natives, and to reduce large bodies of such natives to the comparatively hopeless condition of day laborers, or worse.

For instance, the establishment of large estates in the Igorot country of Northern Luzon would inevitably draw large numbers of the able-bodied men away from their marvellous rice gardens, for the ready money of the day laborer and the greater possibilities of obtaining the many coveted things that "civilization" brings to the savage. But that the virility, the enterprise, and the possibilities of the development of a strong native civilization would be increased thereby, might be fairly questioned. So that the matter of the education of native peoples of tropical lands, the settling of their families on permanent farms of their own, and the improvement of their agricultural methods—all so essential everywhere to their personal welfare and their civic growth—has become one of the foremost problems, as also one of the greatest moral responsibilities, facing colonial as well as independent governments.

These problems are new problems, in natural settings, with surrounding conditions, and with human material in the making, far different than are to be found in any temperate regions. To attempt to apply the methods, and to immediately ingraft the ideals of other lands and climes, results in difficulties which can only be appreciated by those who have tried to accomplish this, as it were, "by proclamation". Methods will evolve but slowly, and they must be built upon the safe foundation of long and varied experience. That the general intellectual status of the masses must be raised, is granted. That it is often readily capable of being raised, is also generally granted. That it must be raised in constant and specific relation to the greatest life interests of these peoples, with the concomitant development of those interests, and the closer binding of the whole people to them is also granted. And this brings Agri-

culture into the foreground of the whole problem.

Efforts in these directions, of many sorts, are being made under many governments, and form a most interesting study. The great centers for technical work and investigation that have been established in many tropical countries, primarily in many cases for the service of the estate development, have, in later times, been attempting to serve the interests of the whole people. Branch experimental stations and demonstration farms have been established at great expense, but the work of these institutions has often proven quite ineffective and indefinite, owing to the absolute incapacity of the average uneducated native to appreciate the results obtained, the lack of sufficient knowledge to understand the meaning of advice given and the general native addiction to superstition and distrust of things new and foreign. It is impossible, for instance, that a wholly ignorant people could be taught the intelligent use of fertilizers and thus be brought to one of the very fundamental steps in any permanent agriculture. Overcrowding may naturally compel certain simple steps in this direction, as it has in some districts of China, though even in China, over against the rich canal region may be set vast regions that have been almost utterly destroyed for agricultural purposes by the methods of a fundamentally ignorant people.

There must be a leavening influence which shall be felt by the whole people. This can never be effectively, specifically, and economically wielded by the direct and local efforts of foreigners in any such manner as may permanently modify the habits of a whole people. The supreme office of government in this direction must be, above all other things, the teaching of teachers. The people must be led by men from their own ranks. The most effective and far reaching missionary enterprises long ago came down to this basis. The country must be filled with native elementary schools to begin with, to be manned by trained native teachers. School gardens that are neither demonstration farms nor experimental stations, but simple pedagogical tools, should exist in every school, and made living wells of attractiveness and interest, aiming to inculcate from the beginning familiarity with plants and the growing of them, deep interest in them and abiding love for them. Not for years will it be possible to have the native teacher do more than this with the school garden. From these schools the brightest children should be carried on to the High School, and here should be laid the broad foundations in mathematics, physics, chemistry, botany, and language, that shall make a modern technical agricultural training possible. The practical means for drawing the brightest children to the High Schools, has been solved in various ways; if the system is what it should be, they will come of their own accord.

The center and soul of this whole system, so far as agriculture is concerned, must be the agricultural college—a technical school of college grade, where students may receive all the necessary advanced training to make them really expert practical agriculturists. This school should carry not less than a four years' course, and be manned only by the best trained men of any nationality obtainable, from the foremost agricultural colleges and university laboratories of the world. The existence of a single man in any chair in an agricultural college, who is not a thorough master of his subject, and not willing or able to live up to the highest ideals and purposes of such a college, may seriously vitiate and

cripple the work of the whole institution. In new countries where a sufficient number of high schools have not yet been organized, a preparatory school, carrying a two years' course, and equivalent to a first class high school, should be incorporated in the agricultural college, so that students may be received directly from the common schools. There are many distinct advantages in this. The preparation of students received from scattered High Schools is usually uneven in character, and commonly the curricula of such schools articulate very poorly with that of the agricultural college, compelling the conditioning of many students from such sources before they can enter the regular work in the agricultural college. On the other hand, the preparatory school within the college is calculated to fit students for just this college, and the work being done on the same ground, with constant reference to agricultural crops, methods, and conditions, in the elementary botany and other subjects, and the use of material drawn from these sources in the laboratories, is an immense advantage. Indeed it might not be going too far to say, judging from actual experience, that with this preparatory school under the same general direction as the agricultural college, better results are obtainable than by any other system.

Finally, from among the graduates of the agricultural college are chosen those few of especial brilliance and capacity to be sent abroad by the general government for still more advanced training in the best foreign schools. Such men, on their return, can then be used in government bureaus, experimental stations, and in the constantly growing agricultural college itself. The greater number of the graduates will return to their home districts trained agriculturists, to teach in the schools, and to manage plantations and farms. In either case they will form an active and widely distributed leaven, since every one going into active agriculture will be operating what is to all intents and purposes a demonstration farm, and with far greater and more effective possibilities than a few government demonstration farms under foreign employees, could possibly have. Within a few years of active operation of the agricultural college, hundreds of its graduates become distributed throughout the country, and the chances for the rapid introduction of new methods, new crops, new machinery, and new hopes, become greater than would be possible by any other means.

It is really a revelation for one who has not been here before, to see the work being accomplished at the College of Agriculture of the University of the Philippines—to step into a first class modern chemical laboratory and find there a large number of keen well trained students, representing all the principal tribes of the Philippines such as Ilocanos, Bicols, Tagalogs, Pampangans, Visayans, Cagayanes, and even men from the Moro Province, analyzing soils, plant products, and fertilizers, to see them working with microscopes and physiological apparatus in the botanical laboratory, to see them surveying and levelling in the fields, taking charge of their own field cultures and experiments, and in all directions working out results that would be a credit to agricultural college students anywhere. It all gives positive assurance of the practical possibilities in development along these lines in the tropics. Even here in the Philippines, the work is yet very young, and is being rapidly strengthened and perfected in innumerable ways. The day must come, and that soon, when the majority of tropical countries have such institutions well organized, fully equipped, and in active operation.

The site of an agricultural college in the tropics is a matter of primary importance. The great tropical crops like rubber, cane, corn, cacao, tobacco, coffee, coconuts, rice, spices, fibres, and so on, are very varied in their requirements, so that varied conditions and topography in the college farm are a prime essential. Where this is not possible within the limits of a single farm, even though it be sufficiently large, the conditions may often be obtained in several closely connected stations. A location at the foot or on the slopes of a mountain, with irrigable lowlands near at hand, and higher and varied country just above, all with abundant water supply, make ideal surroundings for the college plant. No greater mistake can be made than to locate it within city limits, both for the sake of the students and the work, or to place it in any locality suitable to only a limited class of cultures. Nor should the size of the farm be too limited. There should be ample space for the Animal Industry work, in pastures, pens, and feeding lots. Permanent tree plantings of great variety must be made —for instance in coffee, cacao, coconuts, citrus and other fruits,—these being arranged both as to variety and also in contemplation of extensive fertilizer and other tests, and all these require space. There is a large class of semi-permanent cultures, including certain fibres, cane, and various tropical root crops, and these also require ample space under varied conditions. Finally there is the great number of annual cultures of every description to be provided for. The farm is preeminently the most important laboratory in the college. Without it the college would be like a medical school without hospital or clinic, or a law school without the courts. Students must have practical work, and opportunities for technical investigations in all the standard tropical crops, and with all phases of their handling, else the very purpose for which the college was founded becomes unattainable, and its results impractical and ineffective.

The animal industry department should possess small herds of all the domestic animals deemed possibly adaptable to the climate and conditions involved, with sufficient numbers for breeding, dairy work, feeding experiments, and for carrying on the current work of the farm. Without these, lectures and proposed work in animal industry are a mere sham. A course in the simpler phases of veterinary science and farm sanitation is one of the essentials in agricultural training, and this is particularly and especially true in the tropics where animals can be kept in health and vigor only by adequate knowledge and eternal vigilance.

The machinery used in tropical agriculture in connection with the handling of coffee, cacao, fibres, rubber, cane, rice, and other crops, is mostly the development of very recent years. Small, or unit, forms of these should be installed on the farm and kept in working order. It is immaterial whether crops be at hand at the time for their employment or not. Every student should be familiar with every working part of them, and should himself operate them, oil them, dismount and remount them, and know thoroughly the principles on which they work. An agricultural college that should graduate students without this knowledge, as well as the ability, for instance, of operating simple forms of agricultural power engines both for coal and oil, would be richly worthy of severest possible censure. Certainly its students would not be able to open up and intelligently direct a modern tropical plantation, without at least certain portions of this training. The

work with machinery requires a trained instructor who is a practical machinist, and who can also have charge of elementary instruction in the use of modern farm tools, as well as have charge of the upkeep of the entire equipment in this direction. A small blacksmith and repair shop will be a necessary item in this department. Students must be taught to do such things as weld, temper, thread a bolt, repack a valve, and all simple repair work, as well as horse-shoeing.

The work with fertilizers should be especially complete and comprehensive, and to this end, abundant stores of all available manures should be constantly on hand, and in constant use by the students.

The work in rural engineering, covering surveying, levelling, farm constructions, irrigation and drainage, should be thorough and very practical, and this requires a trained engineer who should also be instructor in physics, and it also necessitates ample equipment.

To underlie all this practical and most essential actual operation and field investigation, and to render it even at all possible, there must be a preparation so broad and well founded as to insure thorough capacity, clear understanding, and masterly efficiency. The curriculum must, of course, include broad and thorough preparation in botany—the technical study of plants, their growth phenomena, their complex metabolic operations, and their intricate relations to the soil and to surrounding conditions—so that the student will be able always to work intelligently and think clearly in all matters affecting them. This, with the help of chemistry and physics, forms the scientific basis for modern agriculture. Well equipped and well manned laboratories for these lines of work are among the first things of all to be thought of in the real agricultural college organization.

All the modern methods in agriculture necessary to most economically and efficiently produce the maximum crops, may be unavailing, when injurious insects or parasitic fungous diseases attack the plants. The annual losses from these causes alone, throughout the world, run into the hundreds of millions, frequently completely destroying the industries of whole regions. Practical work along these lines is agricultural insurance of a most effective and necessary order. Students in the Agricultural College should be given thorough training in Plant Pathology and Economic Entomology, which shall effectively arm them for the work of the future, and these lines require special laboratories and equipment, and specially trained teachers.

Two years each of French and German are now generally regarded as indispensable. Many of the best tropical agricultural journals extant, large numbers of the best works in agricultural science, as well as some of the most important publications of current results, are written only in these two languages. Without them a student is handicapped in such a way that up-to-date work is utterly impossible to him.

Steering between inefficiency on the one hand, and extreme narrowness of intensive training on the other, the agricultural college must make itself also, in so far as it can, a school for citizenship. Its graduates are likely to become influential men among the masses, and they must be prepared for their responsibilities. Courses in Agricultural Economics and Farm Management, as well as general lectures—by the most competent public men where possible—on agricultural policy, agricultural coöperation, relation of the

state and the community to agricultural development, and similar broad treatments of agriculture in its various human phases, should certainly be given.

The question of ample personnel and labor in the agricultural college, is always an acute concern. The college farm cannot be operated by students without seriously interfering with their studies, to say nothing of the many difficulties arising from the inevitable irregularity of their hours. An adequate labor force is a prime necessity. Cultures on the farm intended to do well, should do better than those on any surrounding native farms, or discredit and distrust will infect both students and community. This will offset the many negative results that are a necessity in all experimental work. As a great public institution representing the highest development of Agriculture, the general upkeep of the place throughout should be a model of thrift, care and neatness. Lack of proper provision for labor is costly economy, and a fatal oversight.

In the early development of the Agricultural College, a school of Forestry can very well be associated with it at great economy, since the basic work and equipment is much the same for both.

The installation of an Agricultural College, with all of its necessary buildings and equipment, involves a considerable initial outlay. Its permanent support should be provided for in such a definite and direct manner, as shall insure entire security from the uncertainties of political favor. The Morrill Bill and other acts, accomplished this for the very numerous and splendidly outfitted agricultural colleges in the United States. Stating this support in terms of small but adequate percentages on certain government revenues, insures the permanence of all its work, and insures its gradual and reasonable development in direct and fixed proportion to the development of the country's general welfare. This has never yet, however, precluded the necessity for occasional special appropriations.

CURRENT LITERATURE

The annual report of the Mauritius Agriculture Station for 1910, published in 1911, contains information on a considerable number of subjects. The sugar crop for the year was 215000 tons as against the record yield or 245000 tons in 1910. The station has made prolonged and extensive investigations on the use of fertilizers and on the selection of seed canes. For details as to results of this work, the report must be consulted.

Experiments were made with Roselle (*Hibiscus Sabdariffa*), which was previously in cultivation in some gardens in Mauritius. It is there planted from December to March and spaced six feet in each direction. Brief directions are given for making jellies, sauces and wine. In case of abundant crops, it is recommended that the calices be dried as they keep well in this condition. Analyses made in the Réduit Laboratory show the following results:

	Fresh	Dry.
Water	89.90	
Ash	0.80	7.97
Cellulose	1.43	14.16
Sugars	1.15	11.42
Non-nitrogenous matter	5.66	56.08
Nitrogenous matter	1.06	10.37
	100.00	100.00

Instigated by d'Hérelle's work on the utilization of Sisal fiber, published in "Journal d'Agriculture tropicale" of June, 1910, experiments were made at Réduit on the leaves of sisal, maguey, and Mauritius hemp, with special attention to the last. As a result of these experiments the conclusion was reached that the leaves of none of these plants could profitably be used for the production of either alcohol or paper. For either of these uses sugar waste is more appropriate.

Cultural experiments have been made with a large number of legumes. Reports on these are found in the annual report of the station and in Bulletin No. 24 issued in 1910. Such full reports as these cannot be taken up in a review. It is of interest to note that in spite of a number of failures the Director of the station remains of the opinion that the Soy bean is a plant of great promise for culture under the tropical conditions existing in Mauritius. The failures are ascribed most frequently to the absence of the proper bacteria in the soil, or in individual cases to attacks by various pests. Planting from December to March, a satisfactory crop of mature seed has been harvested in two and one-half to three months.

The annual report for 1911, received after the above had gone to press, shows that the hopes entertained in the matter of Soy beans have not been realized. Responsibility for this failure is laid chiefly to typhoons. The work is being kept up, and it is hoped that by means of selection from a large number of varieties, one will be found which is sufficiently resistant and vigorous. Like many other legumes, native and introduced, the *Soja* is subject to destruction by the bean fly (*Agromyza*). The interesting work of this station on miscellaneous legumes as cover crops and for forage or seed is being continued. Among the new ones taken up in 1911 were a *Sophora*, believed to be *S. tomentosa*, introduced from Madagascar, *Tephrosia* introduced from the Comores, and a *Psophocarpus* from the latter source. Of a number of species of *Crotalaria*, *C. retusa* remains the favorite. *C. juncea* is also receiving a prolonged and thorough test. It is not regarded as having any value under Mauritius conditions as a source of fiber, but it is hoped that it is useful enough as a forage to make up its comparative deficiency as a cover crop.

RAMIE (RHEA). CHINA GRASS. THE NEW TEXTILE FIBER. *By Herbert A. Carter. London. Without date of publication, but the preface dated March 1st*, 1910.

This book is representative of a class of works written in Europe by Europeans on tropical products. As in other similar works, the attempt to tell all about the subject has resulted in the compilation of a large amount of published information and misinformation, the text repeating itself or contradicting itself as different writers of disjointed notes and papers have happened to agree or disagree. Thus on page 2 it states that "Rhea, or reeha, riha as it should be written, being the name by which the plant is known in India, might with advantage be given to the Indian produce." Immediately under this, Sir George Watt, who had the advantage of the most intimate personal knowledge of the plant in India, is quoted to the effect that rhea and China grass are probably identical. A little further on, it is pointed out that rhea is in reality the name in Assam and is unknown elsewhere in India.

For the experienced planter, a book of this kind is really valuable. It tells him nothing positively about what ought to be done with a crop, but in a mass of contradictory testimony he will find suggestions which his experience will teach him how to use. To the man without experience, such a work is merely bewildering. If the author himself has first-hand knowledge on which he can base judgments as to which of many conflicting statements is entitled to belief and indicates the best practice, his ability to judge competently is for the most part not evident. And the previously uninformed reader will certainly leave the book with the idea that on various essential points nobody can tell what ought to be done. In the case of ramie or China grass, there is more excuse for this contradictoriness than there is, for instance, in the case of the cocoanut, because there is a real lack of reliable knowledge. For India alone, there is the work of Dr. Watt; but this is not an important Indian crop and Dr. Watt's conclusion is that in most parts of India it offers little promise. It would certainly be unreasonable to conclude from this that the crop is not one to be encouraged in other places; but the reliable information as to its culture in lands where it is an established industry or offers real promise to the planter is exceedingly meager. The European standpoint of the author finds expression in the illustrations, of which only two out of twenty-seven have anything to do with the culture of the plant, the remainder being cuts of machinery.

THE RUBBER PLANTING INDUSTRY OF CEYLON *by R. H. Lock. Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon. Volume VI, No. 7, February*, 1912.

In very striking contrast to the book on Ramie reviewed above is this paper of eighteen pages written by a man in intimate touch with his subject. It has more definite and practical and reliable information on the production of rubber as a plantation industry than is likely to be found in a heavy book compiled some thousand miles from the scene of operation, and attempting to tell "all about it." The information is so condensed that it cannot be done justice in an abstract; and whoever wants information on rubber as a plantation crop should read it and then study it.

The area planted in Ceylon in solid rubber was 184,000 acres in 1910, and is estimated at 190,000 acres in 1911. The export was 1601.3 tons in 1910, and is estimated at 3000 tons in 1911. The average distance between trees is about 15×15 feet, but in good soil 20×20 or even more is now recommended. "As regards the effect of forking or cultivating the soil, opinions differ widely, and no reliable data are available. But it is hardly to be expected that this expensive operation will lead to much financial profit. On level land it is probably better to conserve the surface mulch of fallen leaves, and to imitate forest conditions as closely as possible." Everything in the circular has the same touch of common sense.

Circular No. 8 deals also with rubber. The first part deals with the yield of a tree which was planted in 1876 and had a girth of 115 inches in December, 1911. This tree yielded 174 pounds of dry rubber during twenty-five months of tapping ending January 17, 1911. The tree was tapped daily during April, June, August, October and December of 1911, on an area which had already been worked over during the previous period. During these five months the yield was 67 pounds of dry rubber. The yield of rubber at each tapping increased from 145 grams in April to 236 and

234 in October and December. There is in the Heneratogoda Gardens one tree still larger, having a girth of 125 inches.

The second part of this circular deals with the yield of rubber at different levels on the same tree. Of the total quantity of rubber obtained during the experiment 105 pounds were obtained from the six cuts highest up and 174 pounds from the lower six. "The evidence tends to show, though not quite conclusively, that a large part of the rubber yielded is produced locally under the stimulus of tapping." These reports show that a tree will sometimes renew its bark so as to be entirely ready for renewed tapping on the same area within two years and a half; but warning is given that it will in general be safer not to expect this to be the case within four years.

PESTS AND DISEASES OF THE COCONUT PALM. *By Walter W. Froggatt. Science Bulletin No. 2. Department of Agriculture, New South Wales. Second impression.*

The author, who is government entomologist of New South Wales, gives here an excellent summary of knowledge regarding the insect enemies of the coconut. The different insects are described and there are illustrations of the best quality by which any of the more important pests can be recognized without question. In connection with the important pests there are also suggestions as to the methods of combatting them. A few known enemies, such as *Brassolis isthmia* of Panama, the tent-building larvae of which are sometimes very destructive, and *Amathusia phidippus* Linn., which is recorded as living on coconuts in India and has the same habit in the Philippines, are overlooked. On the other hand, there is very interesting information which was not available before with regard to the coconut pests of the South Seas.

The treatment of bacterial and fungus enemies is quite incomplete. There is no mention of Bertrand's work on Pestalozzia, nor of Butler's on Pythium. The notes on bud rot in the West Indies are far from up to date, and no mention is made of bud rot in the Philippines, although this is the only place where an epidemic under full head has been suppressed.

The Tropical Agriculturist **40** (1913) 91, describes and figures a machine for husking coconuts, manufactured by Fr. Haake in Berlin. The machine is evidently simple and well built, and is sold for 260 marks, or about ₱150 delivered in the Philippines. It is said that "A skill workman can remove the fiber from as many as 100 nuts in an hour." Expert Filipinos using the old method of husking, by means of an iron spike standing at about the height of the knee, frequently husk nuts more rapidly than this machine is said to do.

A statement is going around as to the effect of irrigation in India, to the effect that the excess of production by irrigated rice over unirrigated is in Madras 20% and in the Punjab 40%, the corresponding increase for wheat being in the United Provinces 45% and in Bombay 100%. And yet rice is regarded as the grain which demands irrigation.

The Journal of the College of Agriculture, Tokyo, Volume I, No. 4, is a paper on Oryzanin by Suzuki, T. Shimamura and S. Odake, written in the German language. Oryzanin is the name given to a substance contained in the outer part of the rice grain. If polished rice, that is rice from which this outer

coat has been removed, is fed exclusively to chickens, dogs, mice and other animals, it results in loss of weight and finally in death. It is also widely held of late that the use of such rice is responsible for beri-beri. The authors find that the symptoms produced by the use of polished rice can be readily cured by the use of small doses of their oryzanin. From their experiments, they conclude:—

"Oryzanin has in the economy of animal life a special position, like albumin, fat and carbohydrate, and an equally important one. Without oryzanin the other food materials cannot perform their functions. A diet which does not contain oryzanin cannot permanently support life. Artificial mixtures of albumin, carbohydrate, fat and salts, without oryzanin, cannot maintain the life of the animal."

It is found that substances taking the place of oryzanin are present in various sources of food as in wheat, barley, beans, and various vegetables. Barley which has been treated like polished rice does not lose its value in this respect. Whether the substances which perform the same function, in other food materials than rice, are identical with oryzanin is not determined.

Circular No. 119, Bureau of Plant Industry, U. S. A., Department of Agriculture, is a most interesting paper on the grafting of the papaya, by Fairchild and Simmonds. If the young leafy sucker of a papaya tree having about the diameter of a lead pencil be cut off and sharpened to a wedge point and inserted in a cleft in a decapitated young seedling, which is split with a very sharp and thin grafting knife, there is a strong chance that the grafting will be successful. The leaf surface of the graft should of course be reduced, and the grafted plant should be shaded for a few days after the operation. Grafting potted seedlings in the green house, or under the shade of a lath house, fully 75% of success can be expected. It makes no difference if the stalk be considerably larger than the scion.

The discovery is a decidedly important one as it furnishes for the first time an easy and certain method of propagating particularly good plants without danger of degeneration as a result of cross pollination. The paper contains an interesting review of literature regarding the papaya.

The Tropical Agriculturist was founded in 1881 by J. Fergusson and was published by himself and his successors in business for more than three decades, and developed into the largest publication in any language on tropical agriculture, and the one covering most completely its field. The entire management has now been taken over by the Ceylon Agricultural Society. The few issues which have appeared since the change demonstrate that its old standard is more than upheld. It continues to cover its field and has improved in appearance. A decidedly agreeable change is the abolishing of the supplement and the distribution throughout the body of the magazine of the notes which were previously rather arbitrarily placed in the supplement. The most notable and valuable feature of the Tropical Agriculturist continues to be the thorough manner in which the information published in a variety of places throughout the tropical world is gathered together and reviewed or republished.

Beside the Tropical Agriculturist, the Ceylon Agricultural Society has several other publications, including notably its reports of progress and its year book.

The Flora of Manila by Associate Professor E. D. Merrill is a milestone in Philippine botany. More than a decade of hard and steady work on the author's part has gone into the preparation of this volume. The book undertakes to include all native plants and all common cultivated plants now to be found in or near the city of Manila. Of these more than a thousand species are listed. As the lowland flora of the Philippines is a very uniform one, there are probably no common plants about any important center of population in the islands which will not be found in place in this book. The work includes a short and very concise and satisfactory general statement covering the use of terms in descriptive botany and a very complete glossary of descriptive botanical terms. There are carefully prepared keys to the families and to the genera and the species. In connection with each species, there is a statement as to its occurrence in the Philippines, and elsewhere, and as to the origin in the case of introduced plants. Vernacular names are also included; in the case of families which have no native names in use the author has probably gone further than was worth while in employing them.

The proofreading has left something to be desired, but not so much as might reasonably have been expected in a first edition of a large work, written by a man whose botanical research has not rested while this flora was being prepared. Altogether the fact that it is the first attempt of its kind in this part of the world might be forgotten, and the book still be regarded as pretty nearly a model of its kind. It has already proven to be of great value to botanists, professional and amateur, as well as to school students of botany.

In the general section of the Philippine Journal of Science, Volume VIII, No. 2, Professor Baker has a paper on Caprification in Ficus Nota and some of our other wild figs. His study has revealed a wealth of detail in the modifications looking to the control of cross-pollination by the fig on the one hand; and a marvellous insect fauna on the other. Beside the insect responsible for cross pollination which is a distinct species of Blastophaga for each species of fig investigated, there have been found a long list of other insects, in part at least parasitic on the figs or the Blastophaga; and all of these insects seem also to be restricted each to a single species of Ficus. In its thoroughness on the botanical and entomological side alike, and from the surprising nature of the organisms and structures discovered, the paper may fairly be regarded as "bahnbrechend." One need be neither a botanist nor an entomologist to find it full of interest.

In the Boletim de Agricoltura of the Brazilian State of Sao Paulo, 1912, page 841, is an urgent appeal to the people of that state to engage in the production of rice until its importation shall no longer be necessary. Among the reasons advanced with particular force are the dangers of importing diseases of men and of plants. In the case of men, it is held that with the rice there are likely to be brought, in the holds of the ship, rats feeding on the rice, and fleas on the rats; in this way bubonic plague might be imported. With regard to plants, it is pointed out that the hills of Ceylon, Java, and other parts of the east were once clothed with coffee plantations, as are those of Sao Paulo today. It is suggested that the spores of *Hemileia* may well have been carried from country to country in sacks of rice, and that there is a real danger that they will reach Brazil in the same way.

The same journal, July 1912, has an interesting paper on the avogado. Except as to the varieties, the treatment is reasonably comprehensive.

The Dutch Department of Agriculture has just published a most interesting and attractive account by Dr. Bernard, of an account of a trip to Ceylon and British India for the study of the culture of tea. The work is complete in text and illustration and will prove a most valuable source of information to those interested in *this crop*.

In the Journal D'Agriculture Tropicale No. 135, is a report by Mr. H. Perrier de la Bathie on the Frosts of Central Madagascar and spring droughts of the East coast. From the study of the reaction of the plants of the center of the island to the frosts, it is concluded that the native flora must have developed in freedom from the frosts which have now become of regular occurrence, and therefore that there must have been a very recent and pronounced change in the climate. The cause of this as well as of the serious droughts of the east coast is found in the deforestation of the island. Three-fourths of the primeval forest has been removed, and the process is still allowed to go on. From a note in the succeeding number of the same journal on Tapia, it appears that in Madagascar as in the Philippines, fire is responsible for the presence of grasslands where the forest is the natural covering of the country.

The Tapia just mentioned is a native tree which serves as the food of a wild silk of considerable local commercial importance, and of business value elsewhere.

In No. 136 of the same journal, is a review by Mr. F. Main of a number of recent papers on the coconut. Among these are the recent book of H. Hamel Smith, Coconuts, The Consuls of the East, Barrett's papers in the coconut number of the Philippine Agricultural Review, a paper by Mr. L. Nemry on copra in the Philippines, published in the bulletin of the society of studies of the Belgian colonies for March 1912, and Zaepernick's Culture of the Coconut, published as a supplement to Tropenpflanzer in October 1911. For the most part the review and the papers cited are alike in the absence of information that had not already found its way into print. But knowledge and practice in coconut culture are so far apart that every publication of the important facts on the subject is useful.

Mr. Main concludes from a study of estimates in all parts of the tropics that it is not safe to estimate that a plantation of 1000 hectares, say 100,000 trees, can be brought into bearing for less than eight or nine hundred thousand francs or nearly two hundred thousand dollars gold.

E. B. C.

Weather Observations for December, 1911.

	RAINFALL.		TEMPERATURE.			
			On Hill		Temporary Building	
Date	*Inches*	*Millimeters*	*Maximum*	*Minimum*	*Maximum*	*Minimum*
1					28.0	23.2
2			29.4	23.0	28.2	23.0
3	0.01	.254	29.5	23.1	28.3	23.9
4	0.02	.508	29.0	23.6	27.1	23.7
5	0.01	.254	28.1	23.5	28.7	23.6
6			29.9	22.6	28.1	23.7
7			27.7	21.9	28.0	22.7
8			29.0	22.2	28.5	22.9
9			29.0	24.7	27.2	24.8
10	0.07	1.778	31.9	23.1	30.7	23.2
11			30.6	22.4	29.2	23.3
12			29.4	24.0	28.7	24.4
13			29.0	22.8	28.0	22.9
14			28.7	20.3	27.2	20.6
15			27.1	22.7	26.1	23.3
16	0.07	1.778	27.0	22.4	26.2	22.9
17	1.58	40.132	29.1	22.2	28.3	23.0
18			28.9	21.8	28.1	22.6
19			28.0	23.1	27.5	23.8
20			27.1	23.0	26.2	23.7
21	0.17	7.318	28.7	22.4	27.2	22.7
22	0.01	.254	28.7	22.5	26.9	22.9
23	0.01	.254	28.7	20.9	27.1	20.6
24	0.03	.762	28.7	22.8	27.7	22.9
25	0.15	3.810	28.6	21.9		22.6
26			27.8	20.3	27.0	
27			28.6	22.3	27.9	22.2
28	0.03	.762	27.7	22.3	26.3	23.1
29	0.02	.508	27.4	20.9	26.5	20.9
30			28.6	20.5	27.4	20 9
31			27.6	20.9	26.9	21.4
	2.18	55.372	28.6	22.3	27.6	22.9

Weather Observations for January, 1912.

	Rainfall		TEMPERATURE			
			On Hill		Temp. Building	
Date	*Inches*	*Mm.*	*Maximum*	*Minimum*	*Maximum*	*Minimum*
1			29.0	21.5	28.1	21.8
2	0.04	1.016	27.9	21.7	27.1	22.7
3			27.4	21.7	26.8	22.0
4	0.13	3.302	26.8	22.2	26.1	22.7
5	0.71	18.034	25.1	22.3	25.0	22.6
6	0.11	2.794	27.8	21.1	27.0	21.9
7	0.01	0.254	26.6	22.3	25.8	22.9
8	0.01	0.254		21.6	27.0	22.0
9			28.0	20.7	27.9	22.8
10			26.3	20.0	25.6	21.2
11	0.16	4.064	27.2	21.8	27.1	22.5
12	0.03	0.762	26.1	22.3	25.6	23.1
13	0.05	1.270	27.9	21.7	27.1	22.7
14			27.2	20.2	26.3	21.6
15			27.7	20.5	27.0	21.7
16			27.8	21.0	27.1	21.7
17			27.8	21.0	27.0	22.1
18			28.0	21.5	27.1	21.7
19			28.1	20.7	26.8	20.0
20			26.8	22.0	25.6	21.9
21			26.9	20.4	25.8	20.9
22			28.0	20.5	27.5	20.6
23			27.6	19.4	27.6	20.2
24			27.9	19.6	27.9	20.9
25			29.0	21.7	28.4	22.3
26			27.7	20.3	27.2	21.6
27	0.10	2.540	25.8	22.0	25.5	21.9
28			26.8	21.2	25.3	22.2
29	0.12	3.048	27.5	19.9	27.3	20.7
30	0.03	0.762	26.0	20.9	6.3	21.8
31	0.03	0.762	26.3	21.3	25.8	21.9
Total	1.53	38.862				

Weather Observations for February, 1912.

	Rainfall		TEMPERATURE			
			On Hill		Temp. Building	
Date	*Inches*	*Mm.*	*Maximum*	*Minimum*	*Maximum*	*Minimum*
1	0.04	1.016	28.6	20.9	28.4	21.9
2			28.2	20.1	28.1	21.0
3	0.35	8.890	23.3	19.9	24.1	21.1
4	0.28	7.112	26.7	20.9	26.9	20.4
5	0.41	10.414	25.2	21.2	25.3	22.8
6	0.31	7.874	25.5	21.9	25.0	22.6
7	0.12	3.048	26.4	20.7	25.0	20.9
8	0.03	0.762	26.9	20.6	26.0	20.9
9			28.2	19.9	26.6	20.5
10			28.0	21.0	26.8	21.8
11			28.2	20.6	26.4	21.7
12			28.9	22.0	27.7	22.0
13			28.6	21.0	27.4	22.5
14			28.0	19.8	27.7	21.3
15			28.0	22.0	28.0	23.4
16			29.0	24.0	28.0	24.3
17	0.02	0.508	30.3	23.6	29.1	23.9
18	0.03	0.762	28.0	23.0	27.0	23.9
19	0.04	1.016	28.9	23.8	27.7	23.5
20			27.8	23.8	26.5	23.5
21	0.10	2.540	25.6	22.0	25.1	23.1
22	0.03	0.762	31.9	21.0	30.0	21.9
23			28.3	22.0	27.8	23.8
24			30.4	23.0	29.0	24.0
25			29.9	22.0	29.0	22.7
26			30.4	20.9	29.4	22.8
27			30.7	21.8	29.4	22.9
28			29.6	22.0	28.7	22.4
29			29.7	20.7	29.0	21.7
Total...	1.76	44.704			27.4	

Weather Observations for March, 1912.

	RAINFALL		TEMPERATURE			
			On Hill		Temp. Building	
Date	*Inches*	*Millimeters*	*Maximum °*	*Minimum °*	*Maximum °*	*Minimum °*
1			27.9°	22.6°	27.0°	23.1°
2			28.5°	21.2°	27.8°	22.0°
3			30.0°	21.6°	28.8°	22.9°
4			30.9°	20.7°	29.8°	21.7°
5			29.0°	21.0°	28.0°	21.9°
6			31.0°	22.4°	29.9°	23.6°
7			30.1°	22.3°	29.7°	24.0°
8			30.3°	22.1°	29.5°	23.6°
9			30.9°	23.5°	30.4°	24.9°
10			30.7°	22.0°	29.0°	23.7°
11			31.1°	24.8°	30.0°	23.0°
12			33.7°	21.0°	32.0°	22.3°
13			33.5°	21.0°	32.0°	22.8°
14			33.5°	22.6°	31.5°	24.0°
15			32.5°	22.3°	31.1°	23.9°
16			31.0°	22.0°	30.1°	23.9°
17			31.0°	21.4°	29.5°	22.9°
18			31.0°	21.4°	28.9°	22.5°
19			25.3°	22.0°	25.1°	23.7°
20			29.8°	22.9°	29.5°	22.9°
21			31.7°	21.1°	30.0°	22.0°
22			30.0°	23.2°	29.7°	23.8°
23			29.3°	23.4°	28.6°	24.7°
24			30.7°	22.1°	30.0°	23.6°
25			32.0°	22.8°	31.1°	24.1°
26			31.6°	21.5°	30.1°	22.9°
27			31.1°	22.9°	30.3°	24.2°
28			30 0°	22.9°	28.7°	23.9°
29			31.0°	21.7°	29.9°	23.2°
30			31.2°	23.1°	31.0°	24.0°
31			30.6°	23.1°	29.0°	24.7°

Weather Observations for April, 1912.

	RAINFALL		TEMPERATURE			
			On Hill		Temp. Building	
Date	*Inches*	*Millimeters*	*Maximum °*	*Minimum °*	*Maximum °*	*Minimum °*
1			29.5°	21.9°	29.0°	23.5°
2			30.4°	22.3°	29.1°	23.7°
3			30.8°	21.9°	29.9°	23.5°
4			29.9°	23.0°	28.9°	23.6°
5			31.5°	22.6°	30.9°	23.7°
6			32.0°	22.7°	31.4°	23.9°
7			32.0°	22.0°	30.1°	24.4°
8			31.7°	22.7°	31.1°	24.0°
9			32.0°	22.5°	31.4°	23.8°
10			32.4°	24.7°	31.5°	25.3°
11			32.0°	23.5°	30.9°	25.2°
12			33.7°	24.5°	32.0°	25.5°
13			31.0°	24.0°	30.0°	25.0°
14	0.13	3.302	29.0°	22.9°	28.8°	24.2°
15			31.0°		30.6°	23.4°
16			32.0°		31.0°	23.6°
17			31.3°	22.5°	30.4°	24.4°
18			31.9°	22.7°	31.0°	23.9°
19			31.5°	24.0°	31.7°	24.7°
20			32.1°	23.5°	30.8°	26.0°
21			32.1°	23.9°	31.6°	25.1°
22				24.0°	30.8°	25.2°
23			32.2°		30.7°	24.7°
24			32.0°	24.0°	32.0°	25.0°
25			32.4°	24.0°	31.6°	25.0°
26			32.6°	23.1°	31.6°	24.4°
27			31.9°	22.4°	32.8°	24.0°
28			31.4°	24.8°	29.6°	25.4°
29			33.5°	24.1°	32.0°	25.4°
30			33.6°	26.0°	32.4°	26.2°

Weather Observations for May, 1912.

	RAINFALL		TEMPERATURE			
			On Hill		Temp. Building	
Date	*Inches*	*Millimeters*	*Maximum °*	*Minimum °*	*Maximum °*	*Minimum °*
1			32.8°	24.8°	32.1°	25.4°
2			32.4°	25.6°	31.8°	26.7°
3			32.3°	23.5°	31.9°	24.9°
4			33.0°	24.1°	32.7°	25.3°
5			33.1°	24.0°	32.8°	25.2°
6			32.9°	22.9°	31.4°	25.3°
7	0.69	17.526	33.9°	22.3°	32.8°	23.8°
8	0.10	2.540	28.8°	23.9°	28.8°	25.6°
9	0.90	22.860	32.0°	23.8°	31.0°	24.4°
10			32.0°	23.5°	30.9°	25.1°
11			31.0°	23.7°	30.0°	24.9°
12			32.8°	23.5°	32.6°	25.1°
13			34.2°		33.3°	24.8°
14			33.5°	23.8°	32.9°	25.1°
15			33.0°	23.6°	32.5°	25.0°
16			33.2°	23.7°	32.9°	25.6°
17			33.4°	22.5°	32.2°	24.2°
18			33.8°	23.4°	32.9°	25.2°
19			33.1°	24.8°	32.9°	25.9°
20			34.4°	25.2°	33.3°	26.9°
21	1.04	26.416	30.0°	24.0°	29.6°	25.9°
22			32.0°	22.7°	32.1°	24.6°
23			31.8°	23.9°	31.0°	25.7°
24			32.1°	23.7°	32.4°	25.1°
25	1.29	32.766	32.7°	23.7°	32.2°	24.9°
26			32.3°	23.0°	32.1°	25.1°
27	0.06	1.524	33.1°	24.0°	33.0°	25.0°
28			31.6°	24.0°	31.3°	24.9°
29			32.0°	23.8°	32.3°	24.6°
30			32.6°	24.6°	31.7°	25.0°
31	2.00	50.800	31.9°	24.0°	31.8°	24.9°
	6.08	154.432				

Weather Observations for June, 1912.

	RAINFALL		TEMPERATURE			
			On Hill		Temp. Building	
Date	*Inches*	*Millimeters*	*Maximum °*	*Minimum °*	*Maximum °*	*Minimum °*
1	0.81	20.574	30.0°	23.4°	30.9°	23.9°
2			31.9°		31.1°	24.7°
3	0.03	0.762	32.5°	26.1°	31.8°	25.6°
4			32.6°	24.0°	31.5°	23.4°
5			31.7°	25.4°	30.8°	25.1°
6			33.0°	22.7°	32.5°	23.3°
7	0.13	3.302	32.7°	23.9°	32.5°	24.6°
8					30.0°	24.9°
9	0.71	18.034	28.3°		29.1°	24.0°
10			31.1°	22.4°	30.0°	22.9°
11			30.1°	22.8°	29.7°	23.1°
12			31.4°	23.4°	30.9°	24.1°
13			27.0°	22.6°	27.0°	24.5°
14	0.25	6.858	30.5°	22.4°	30.4°	23.0°
15	0.09	2.286	29.7°	22.8°	29.5°	22.9°
16			30.9°	23.0°	30.3°	23.8°
17	0.01	0.259	32.0°	22.1°	31.8°	23.6°
18			32.1°	23.1°	32.5°	24.2°
19			32.0°	22.9°	32.1°	24.2°
20			33.1°	23.9°	32.7°	25.0°
21			33.6°	23.0°	33.0°	23.9°
22	0.07	1.778	31.9°	21.9°	31.1°	23.2°
23			30.9°	23.0°	30.1°	25.0°
24	0.11	2.794	31.0°	22.2°	30.6°	23.1°
25			32.0°	21.9°	32.0°	23.0°
26			32.7°	23.1°	31.8°	24.9°
27	0.14	3.556	31.4°	24.0°	30.8°	23.7°
28	0.06	1.524	31.9°	23.0°	30.9°	24.9°
29	0.06	21.524	31.3°	21.0°	31.1°	23.0°
30	0.70	17.780	32.0°	21.9°	31.1°	23.3°
	3.19	81.026			30.9866	24.0266

Weather Observations for July, 1912.

	RAINFALL		TEMPERATURE			
			On Hill		Temp. Building	
Date	*Inches*	*Millimeters*	*Maximum °*	*Minimum °*	*Maximum °*	*Minimum °*
1			31.0°	23.9°	31.0°	23.2°
2			32.1°	24.1°	30.5°	24.8°
3			31.1°	23.9°	29.9°	24.8°
4	2.08	53.0	29.9°	24.0°	28.2°	24.9°
5	.30	7.7	31.4°	23.9°	30.1°	23.5°
6			32.0°	22.9°	31.0°	23.0°
7			32.0°	23.9°	31.5°	24.2°
8	.20	5.	28.7°	23.3°	29.1°	23.6°
9	1.61	41.	26.8°	23.5°	28.7°	23.7°
10			30.7°	22.6°	29.2°	23.0°
11			30.5°	23.1°	29.0°	23.2°
12			31.6°	23.7°	29.1°	23.1°
13			30.0°	23.2°	27.3°	23.4°
14	3.15	80.	29.0°	23.2°	28.1°	22.9°
15	.43	11.	31.0°	23.5°	26.5°	22.5°
16	.04	1.	28.1°	23.5°	25.4°	22.4°
17	.98	25.	26.2°	23.2°	25.0°	22.8°
18	4.41	112.	26.6°	22.4°	25.0°	22.4°
19	3.15	80.	27.9°	23.3°	27.1°	23.4°
20			28.9°	22.4°	28.2°	22.6°
21	2.76	70.	26.4°	23.6°	25.1°	23.9°
22	.22	6.	27.3°	23.5°	27.0°	23.9°
23			29.1°	23.1°	24.4°	23.2°
24			29.8°	22.5°	25.3°	23.0°
25	1.93	49.	30.0°	23.0°	26.6°	24.3°
26			28.4°	21.9°	26.0°	24.0°
27			28.1°	22.5°	29.0°	23.6°
28	2.13	54.	26.5°	22.4°	27.9°	24.1°
29	2.32	59.	27.0°	22.1°	27.0°	23.7°
30	.79	20.	23.9°	21.1°	28.6°	23.5°
31	1.45	37.	24.8°	20.9°	29.1°	22.5°

Weather Observations for August, 1912.

	RAINFALL		TEMPERATURE			
			On Hill		Temp. Building	
Date	*Inches*	*Millimeters*	*Maximum °*	*Minimum °*	*Maximum °*	*Minimum °*
1	0.59	15.	25.9°	22.7°	30.0°	23.6°
2	1.14	29.	25.3°	23.5°	29.1°	22.2°
3			28.0°	21.5°	29.1°	24.0°
4			25.8°	21.2°	27.5°	23.8°
5			28.1°	21.2°	27.5°	23.1°
6	.82	21.	27.6°	20.6°	25.8°	23.0°
7	.43	11.	27.1°	21.4°	27.3°	23.0°
8			27.9°	21.0°	29.7°	23.2°
9	.20	5.	27.8°	21.1°	30.8°	23.9°
10			26.4°	21.1°	29.1°	23.5°
11	4.84	123.	27.1°	20.4°	28.3°	24.1°
12	1.93	50.		21.0°	30.0°	23.0°
13	.86	22.	24.0°	20.6°	26.6°	23.4°
14			26.0°	20.2°	28.5°	22.8°
15	2.64	67.	26.9°		28.1°	23.0°
16					28.3°	23.6°
17					27.8°	23.0°
18	2.52	64.			28.0°	23.9°
19					28.8°	23.9°
20	1.22	31.	30.0°	23.9°	29.0°	23.4°
21	2.56	65.	27.1°	22.7°	27.4°	23.0°
22			28.1°	23.8°	28.2°	22.8°
23			29.9°	22.7°	30.0°	23.5°
24			27.7°	23.1°	27.7°	24.0°
25	6.65	170.	26.0°	22.0°	26.5°	23.7°
26	2.87	73.	26.0°	21.4°	26.8°	22.9°
27	.27	7.	26.7°	22.1°	27.1°	23.0°
28	.55	14.	27.0°	23.5°	27.1°	23.9°
29	2.17	55.	28.1°	23.9°	28.8°	24.3°
30			28.1°	23.9°	29.1°	24.9°
31	11.81	300.	27.1°	22.8°	27.5°	24.7°
		1122.			854.5°	728.1°
					27.56	23.48

Weather Observations for September, 1912.

	RAINFALL		TEMPERATURE			
			On Hill		Temp. Building	
Date	*Inches*	*Millimeters*	*Maximum*	*Minimum*	*Maximum*	*Minimum*
1		285	27.1°	20.3°	24.6°	23.0°
2		16	24.9	21.0	24.8	22.7
3		25	24.9	22.3	23.6	22.1
4			27.4	21.9	26.6	22.0
5			30.2	22.0	28.5	21.7
6			29.7	21.5	28.5	21.8
7		27	28.9	22.6	28.1	23.8
8	67	100	24.0	21.3	24.0	22.9
9	53		28.0	22.0	27.0	22.9
10			30.3	24.0	29.8	23.3
11			30.2	23.4	29.1	23.9
12	2	8.5	30.7	24.3	30.0	25.0
13	10	51	28.4	23.9	27.1	23.9
14	69.5	10	29.5	23.5	27.4	23.3
15			30.2	25.9	29.1	24.7
16		7	29.5	27.2	29.0	25.6
17	4.3	14	29.8	25.3	27.8	25.0
18	13.3	0.5	29.0	23.7	28.9	23.9
19		83	28.0	23.8	27.2	24.0
20	84.0		30.0	22.8	30.0	23.1
21			30.8	23.7	30.6	24.6
22		3	29.6	22.9	29.0	23.8
23		52	29.7	23.3	29.0	23.9
24	47.0		27.6	23.9	27.2	24.0
25		10	30.0	24.3	29.1	24.2
26	10.1	1.5	30.5	23.0	30.1	23.9
27	1.9		29.7	24.2	29.0	24.9
28	11.9	55	30.4	26.2	29.4	25.3
29	49.0		29.0	24.8	28.0	25.0
30		27	26.3	23.0	26.2	23.1
	423.0 326.0 749.0	775.5	28.14	23.40	27.99	23.70

Maximum temperature—30.8—Day 21.
Minimum temperature—21.0—Day 2.
Greatest rainfall in one day 285 mm.—Day 1.
Number of rainy days—18.

Weather Observations for October, 1912.

	RAINFALL		TEMPERATURE			
			On Hill		Temp. Building	
Date	*Inches*	*Millimeters*	*Maximum*	*Minimum*	*Maximum*	*Minimum*
1	25.0		29.4°	22.9°	29.4°	23.0°
2			28.7	22.9	29.1	24.0
3		8.0	28.1	22.8	28.0	24.0
4	5.0		27.4	22.6	26.4	23.0
5	117.0		29.1	23.6	30.0	24.0
6		224.0	27.5	23.4	28.0	24.4
7	103.0	40.	26.2	23.3	27.0	24.5
8	39.2	18.	27.0	22.5	26.1	22.9
9	17.1		28.0	23.1	27.7	23.0
10	2.0	71.	28.3	22.7	28.6	22.9
11	51.0	66.	28.0	22.8	27.3	23.9
12	60.3		29.9	22.1	29.4	22.2
13	1.5	6.	27.7	24.9	27.6	24.1
14	7.0	46.5	28.0	24.2	26.9	24.0
15	44.0	71.0	27.0	22.5	27.0	22.4
16	71.5	268.0	25.8	22.9	25.7	23.0
17	227.0	38.5	25.4	22.6	25.4	22.5
18	74.5	29.7	29.7	23.8	29.1	23.8
19	6.0	12.	27.9	23.6	27.8	23.8
20	9.5		29.0	23.6	27.7	23.7
21		36.5	25.1	23.9	25.7	24.0
22	39.2	4.6	26.9	23.6	27.0	23.6
23	5.2		28.0	23.9	28.7	23.9
24	5.0	4.9	27.9	23.1	28.0	23.9
25	1.3		28.5	22.0	28.9	22.5
26			30.0	22.0	30.3	23.0
27			30.0	24.6	30.2	24.4
28			30.6	23.9	31.0	24.5
29			29.0	23.0	29.8	23.8
30	0.1	63.0	26.7	23.4	27.4	24.0
31	67.0		28.4	24.0	29.2	23.8
Total...	978.4	978.0				

Total rainfall 978 mm.

No. rainy days 23.

Largest amount in one day 227 mm.—day 17.

Highest recorded 31°—day 28.

Lowest recorded 22°—days 25 and 26.

Weather Observations for November, 1912.

Date	RAINFALL.		TEMPERATURE			
			On Hill		Temp. Building	
	Inches	*Millimeters*	*Maximum*	*Minimum*	*Maximum*	*Minimum*
1	0.1		28.9°	23.0°	29.0°	23.9°
2			28.0	24.0	28.2	24.1
3	8.0		29.2	23.4	29.7	23.7
4			29.0	23.0	29.1	24.0
5	2.7	12.5	28.0	22.9	27.9	22 9
6	10.0	98.0	26.2	23.5	25.4	23.9
7	96.5		27.0	24.5	26.6	24.0
8	1.4		28.1	23.5	29.0	23.2
9	35.0	43.0	27.6	23.0	27.8	23.2
10	12.0		29.0	23.2	28.4	23.1
11			28.0	24.1	27.9	24.0
12	1.0		29.0	24.0	28.3	23.8
13			29.0	24.0	28.3	23.6
14			26.9	22.9	27.0	22.8
15	12.0		27.0	23.2	27.0	23.0
16	4.8		28.6	23.4	28.1	23.1
17	1.7	16.5	28.0	23.8	28.0	23.9
18	1.4		28.7	23.2	27.9	23.0
19			29.0	22.7	28.1	22.7
20			29.5	22.9	29.0	22.7
21	75.0	76.3	26.8	23.0	27.0	23.7
22			27.8	23.1	27.7	22.3
23			27.6	23.6	27.0	22.7
24			27.4	23.9	26.9	24.0
25	53.0	58.1	25.0	24.0	24.8	22.8
26			29.0	23.6	29.3	23.0
27			28.8	22.6	29.1	22.7
28			27.0	23.4	27.1	24.4
29	184.0	188.0	24.9	22.7	25.0	23.1
30	1.5		27.6	22.9	26.0	23.0
	500.1 mm.	492.4 mm.	27.89	23.37	27.69	23.34

Weather Observations for December, 1912.

	RAINFALL.		TEMPERATURE.			
			On Hill		Temp. Building	
Date	*Inches*	*Millimeters*	*Maximum*	*Minimum*	*Maximum*	*Minimum*
1	Tr.		29.0°	23.2°	28.8°	23.3°
2			28.0	23.0	27.3	22.9
3			28.2	22.8	28.1	22.0
4			27.0	22.1	27.0	22.0
5	Tr.		28.1	22.9	28.0	22.1
6			28.3	22.4	29.0	23.0
7			27.6	22.7	27.0	21.7
8	Tr.		26.0	20.1	24.6	20.0
9		27.5	26.9	22.0	25.9	21.6
10	28		25.1	22.1	25.0	22.4
11	Tr.	10.0	25.1	22.9	25.0	22.3
12	12		28.0	23.1	28.4	22.3
13	7		27.0	23.0	27.0	23.0
14	1		27.8	23.1	27.1	22.9
15	0.8		28.7	22.9	27.8	22.5
16		4.3	27.3	22.2	26.4	22.7
17	4	3.5	27.5	21.9	27.1	21.1
18	2		27.1	21.5	26.5	21.1
19			27.4	19.9	27.1	20.2
20			28.9	20.5	28.7	20.8
21			28.5	22.9	28.8	23.0
22			27.9	22.4	26.5	22.1
23			27.0	22.9	26.0	22.7
24		10.6	25.0	23.1	24.9	22.9
25	13	83.2	25.1	21.1	25.0	22.0
26	81	0.8	26.1	21.2	25.1	21.9
27	1		28.1	22.6	27.7	22.0
28	0.5		28.0	23.0	27.8	23.0
29		13.0	25.6	24.1	25.7	23.2
30	14.0	7.0	27.0	23.1	27.1	22.9
31	9.0		27.7	22.8	27.0	22.9
	173.3	159.9	27.3	22.4	26.9	22.2

Number of rainy days 13.
Largest rainfall in one day 81 mm. on the 26th.
Highest temperature recorded 29 on the first.
Lowest temperature recorded. 19.9 on the 19th.
Average temperature 24.7.

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